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# GREENHOUSE GAS ACTION PLAN

NOVEMBER 1995

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## MEETING THE CHALLENGE OF CLIMATE CHANGE

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# British Columbia Greenhouse Gas Action Plan

Dear British Columbian,

We are pleased to present the British Columbia Greenhouse Gas Action Plan.

Scientists are increasingly confident that human activity is contributing to global climate change, which could seriously threaten our environment and economy.

Climate change is a global problem that can only be addressed through national and international cooperation. But we cannot expect that level of cooperation without demonstrating our willingness to act. Fortunately, there are many actions that can be taken now which make good sense, and yield economic and environmental benefits.

British Columbia is committed to the goal of stabilizing provincial greenhouse gas emissions at 1990 levels by the year 2000. This action plan sets out the measures that the province is taking to pursue that goal. It also describes some of the many positive steps being made by industry, communities and the public.

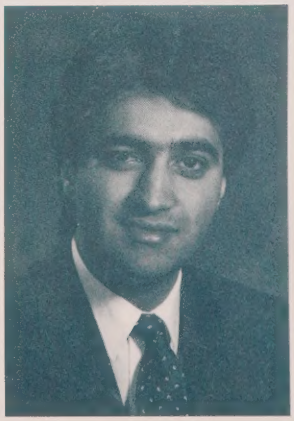
All British Columbians have a role to play in reducing greenhouse gas emissions. We encourage you to do your part in your home, workplace, community and choice of transportation. Our collective actions today can help ensure a healthy planet for generations to come.

Honourable Anne Edwards

Minister of Energy, Mines and Petroleum Resources

Honourable Moe Sihota

Minister of Environment, Lands and Parks



# Summary

Greenhouse gases (GHGs) include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$) and perfluorocarbons (PFCs)[1]. Over the past 100 years, permanent deforestation, fossil fuel use and other human activities have greatly increased atmospheric concentrations of these emissions, with growing signs that they are contributing to global climate change. Global climate change poses a serious threat, and could have major impacts on the world's ecosystems, economy and society.

In its upcoming scientific assessment, the Intergovernmental Panel on Climate Change predicts that average global temperatures could rise 2.5°C by the year 2100. Possible effects of this temperature change include: major alterations in regional patterns of rainfall and drought; increased severity of storms; rising sea levels and temperatures; and extensive flooding of low-lying coastal areas.

At the 1992 Earth Summit in Rio de Janeiro, Canada signed the United Nations Framework Convention on Climate Change (FCCC), and further committed to stabilizing national GHG emissions at 1990 levels by the year 2000. B.C. has endorsed this national commitment and also committed to stabilizing its provincial emissions at 1990 levels by the year 2000.

In February 1995, Canada's energy and environment ministers approved the National Action Program on Climate Change (NAPCC). The NAPCC was then presented to the First Conference of the Parties to the FCCC in Berlin in April 1995. Recognizing that NAPCC measures would not be enough to achieve stabilization at 1990 levels, the ministers agreed to meet again in November 1995, to report on their evaluation of a full range of options. This action plan forms the basis for B.C.'s report.

B.C. accounts for about 10% of Canada's GHG emissions and 0.2% of the global total. In 1990, provincial emissions of $CO_2$ (from non-biomass sources), $CH_4$, $N_2O$ and PFCs were estimated at 58 megatonnes (million tonnes) of $CO_2$-equivalent. Two-thirds of these emissions came from transportation and industry, with the remainder from landfills, residences and businesses.

There are many different measures available to reduce emissions of greenhouse gases, and fewer, limited measures to increase their absorption from the atmosphere. These measures include:

- using energy more efficiently;
- switching to less GHG-intensive fuels;
- making low- or zero-energy transportation choices;
- developing new technologies to reduce emissions; and
- enhancing natural GHG sinks through sustainable resource practices.

B.C.'s approach to greenhouse gas management is guided by the NAPCC principles and the province's strategic and fiscal management plans. This approach:

- embraces the principles of polluter pay, fiscal restraint and weighing of the broader (social, environmental and economic) costs and benefits of GHG measures;
- acknowledges that voluntary action is effective and critical, but may not by itself ensure the necessary reduction in provincial emissions;
- emphasizes early implementation of "no regrets" actions, such as energy efficiency, that are cost-effective and worth taking anyway; and

[1] Ozone-depleting substances, such as chlorofluorocarbons (CFC's) and halons, also contribute to global warming. However, they are not included in this action plan because their phase-out is being covered under another international agreement, the Montreal Protocol.

- recognizes that additional actions, including fiscal and regulatory measures, may be required, but that such actions must first be carefully evaluated.

The B.C. Greenhouse Gas Action Plan has been prepared by the Ministry of Energy, Mines and Petroleum Resources and the Ministry of Environment, Lands and Parks, in consultation with other provincial agencies. Over the last several years, broader input on this issue has been obtained from various stakeholders, most recently through a series of consultation meetings with industry and different levels of government.

B.C. is committed to taking action now to avert global climate change. Therefore, this plan contains more than 50 actions that the province will implement or evaluate further over the next 2 to 3 years. The actions (listed on the following few pages) address all major sources of, and potential sinks for, greenhouse gases.

The measures include seven options for further development. These demand more study and extensive consultation, but could ultimately be needed if sufficient progress is not made through planned initiatives, and public and private sector voluntary action.

The plan documents many significant actions already being taken voluntarily by government, industry and the public, and provides examples of further GHG reduction measures that could be adopted.

There is much uncertainty concerning future growth in B.C.'s GHG emissions and the impacts of specific measures. In particular, the action plan does not quantify the emission reductions from certain actions whose impacts have yet to be estimated, such as:

- industry and local government action as part of the national Voluntary Challenge and Registry program;

- federal actions affecting B.C. under the National Action Program; and

- sustainable forestry and agricultural practices, which the province currently does not regard as providing a significant long-term offset to fossil fuel emissions.

B.C.'s action plan is expected to slow the growth in GHG emissions between 1990 and 2000 to about 2.3 megatonnes or 4%. While a considerable improvement over the 10% expected growth had we done nothing more, this will not result in stabilization. Cutting emissions growth to zero will require strong action from other levels of government and the private sector.

During the coming years, B.C.'s progress in reducing greenhouse gas emissions will be monitored to determine whether additional actions are needed to achieve our emission reduction goals. The B.C. Greenhouse Gas Action Plan will continue to evolve with input from all sectors of society.

## B.C. Greenhouse Gas Action Plan

| Sector | Action |
|---|---|
| **Provincial Leadership** | 1. Develop an Energy Efficient Public Buildings Program for retrofits |
| | 2. Adopt early the B.C. Energy Code for new public buildings |
| | 3. Adopt energy efficiency standards for government office equipment |
| | 4. Evaluate opportunities for renewable energy in public facilities |
| | 5. Institute a fleet purchase policy for government vehicles |
| | 6. Expand employee transportation demand management (TDM) |
| | 7. Launch an Employee Environmental Awareness Program |
| **Energy Conservation and Efficiency** | 9. Develop new financing and delivery mechanisms |
| | 10. Upgrade provincial appliance efficiency standards |
| | 11. Introduce new B.C. Energy Codes for houses and buildings |
| | 12. Launch an Energy Efficient Communities Program |
| | 13. Encourage the use of district energy systems |
| | 14. Develop a home energy rating system |
| | 15. Create a Centre for Building Excellence |
| | 16. Expand energy education and information programs |
| **Transportation** | 19. Put B.C.'s Transportation Strategy into action |
| | 20. Implement a provincial TDM program |
| | 21. Provide infrastructure under the Cycling Network Program |
| | 22. Expand transportation energy efficiency initiatives |
| | 23. Carry out the provincial Clean Vehicles and Fuels Program |
| | 24. Support alternative transportation fuels that reduce GHGs |
| | 25. Jointly sponsor research on renewable fuel technologies |
| **Energy Supply** | 28. Fully implement utility integrated resource planning |
| | 29. Work with utilities on GHG planning |
| | 30. Provide better access to the grid for private power |
| | 31. Support renewable energy through training, etc. |
| | 32. Initiate a review of petroleum and natural gas policies |
| **Forestry and GHG Sinks** | 33. Assess the carbon balance in B.C. forests |
| | 34. Maintain carbon stores through sustainability initiatives |
| | 35. Phase out beehive burners |
| **Agriculture and GHG Sinks** | 36. Encourage agricultural practices that reduce GHGs |

| Sector | Action |
|---|---|
| **Solid Waste Management** | 37. Achieve B.C.'s solid waste reduction goals |
| | 38. Enforce the province's Landfill Criteria |
| **Cross-Sectoral Actions** | 39. Issue formal social costing guidelines for new resources |
| | 40. Work with industry on a pilot GHG offset program |
| | 41. Support pollution prevention planning |
| | 42. Amend provincial policies and processes |
| **Science, Education and Awareness** | 45. Introduce an Environmental Award Program |
| | 46. Jointly sponsor research on adaptation and mitigation |
| | 47. Institute a public education program on GHGs |
| **Local Government** | 48. Support local actions to reduce GHGs |
| | 49. Assist the development of regional growth strategies |
| **National Actions** | 50. Encourage B.C. participation in the Voluntary Challenge |
| | 51. Monitor B.C. voluntary actions |
| | 52. Encourage the extension of federal leadership efforts |
| | 53. Strongly urge an aggressive package of federal measures |

| Sector | Options |
|---|---|
| **Provincial Leadership** | 8. Evaluate options for introducing zero emission vehicles |
| **Energy Conservation and Efficiency** | 17. Evaluate options for social costing in codes/standards |
| | 18. Evaluate options for extending the BC 21 Power Smart program |
| **Transportation** | 26. Evaluate options for a renewable energy requirement in fuels |
| | 27. Evaluate options for fuel switching in B.C. ferries |
| **Cross-Sectoral Actions** | 43. Evaluate options for regulating greenhouse gas emissions |
| | 44. Evaluate options for a tradeable emission permit system |

# Introduction

The scientific evidence is mounting in support of global climate change and the contributing role of human activity. Potential impacts will likely vary around the world—with some regions worse off and some better off—but on a global scale the effects could be large and rapid. Here in B.C., we could experience coastal flooding, changing patterns of precipitation and drought, and losses in our forestry, fisheries and agricultural resources.

Global climate change can only be prevented through cooperative national and international action. All jurisdictions must make commitments to reduce their greenhouse gas emissions. B.C. believes that we should act decisively now to avert climate change. As a result, we have committed to stabilizing provincial emissions at 1990 levels by the year 2000.

Unlike other environmental issues confronting the province, greenhouse gases come from a variety of sources. Historically, industry was looked upon as the number one contributor to atmospheric emissions. While industry is indeed a significant source of greenhouse gases, the transportation sector, and in particular motor vehicles, are the primary source of these emissions. Methane from landfills, and the use of fossil fuels in homes and businesses, are also key contributors.

The diversity of sources makes it imperative that every sector of our economy assume a role in reducing B.C.'s greenhouse gas emissions. Action is needed from all levels of government, industry and the general public. Only a concerted effort to reduce emissions can move us in the direction of stabilization.

The B.C. Greenhouse Gas Action Plan represents just such a concerted effort. It sets out more than 50 initiatives that the provincial government will implement or develop further during the next two to three years. The plan also documents a number of voluntary actions being taken by industry, other levels of government and the public. Combined, these actions form a strong package of provincial measures that will move B.C. towards the year 2000 goal.

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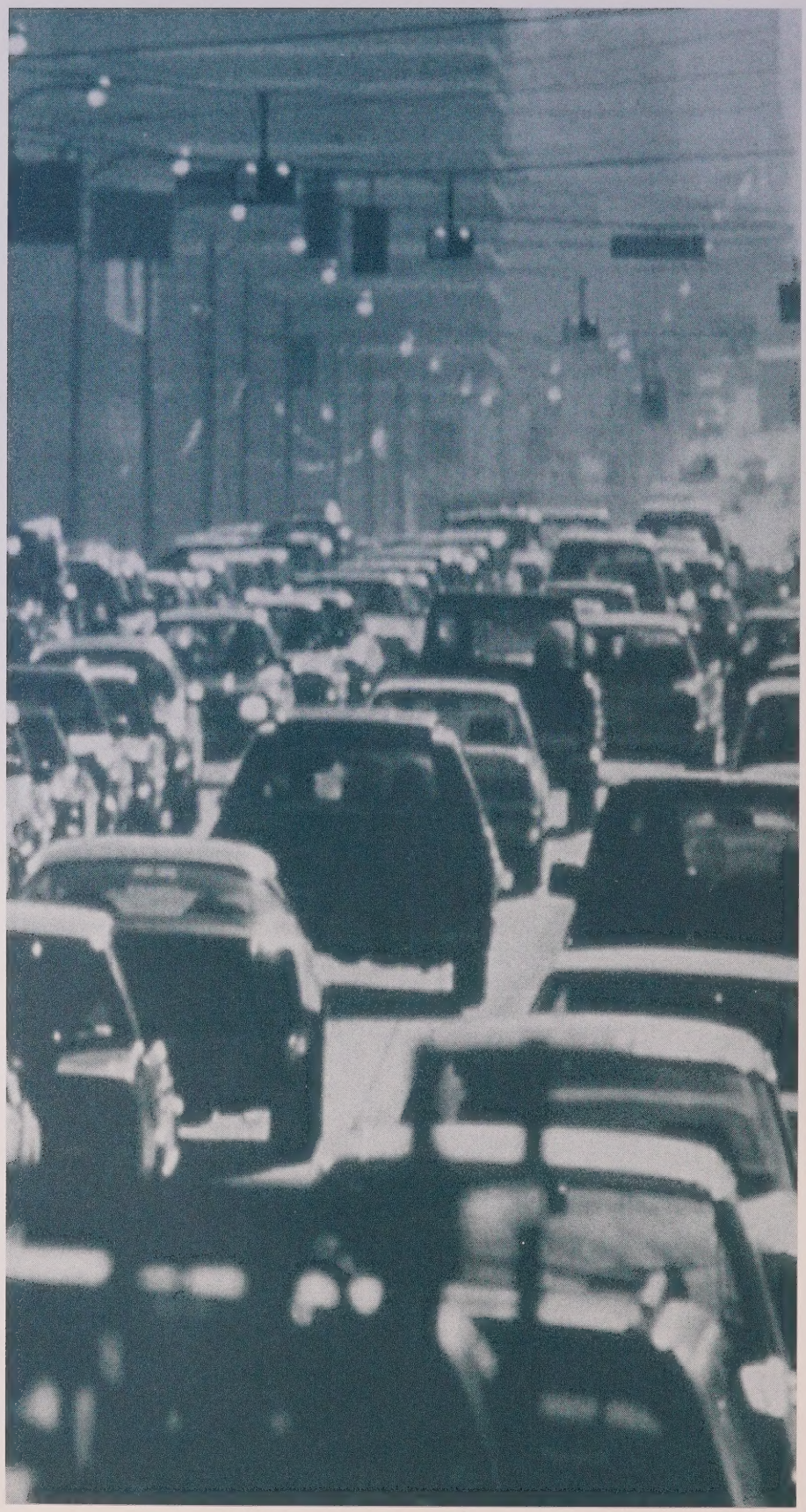
*Daily transportation choices directly affect greenhouse gas emissions*



# The Challenge

There are growing signs that human-caused greenhouse gas emissions are contributing to global climate change, with some serious implications for the world's ecosystems, economy and society. The long-term, global nature of the possible impacts, their uncertain regional distribution, and the need for cooperative action combine to make climate change one of the most challenging environmental threats that we have ever faced.

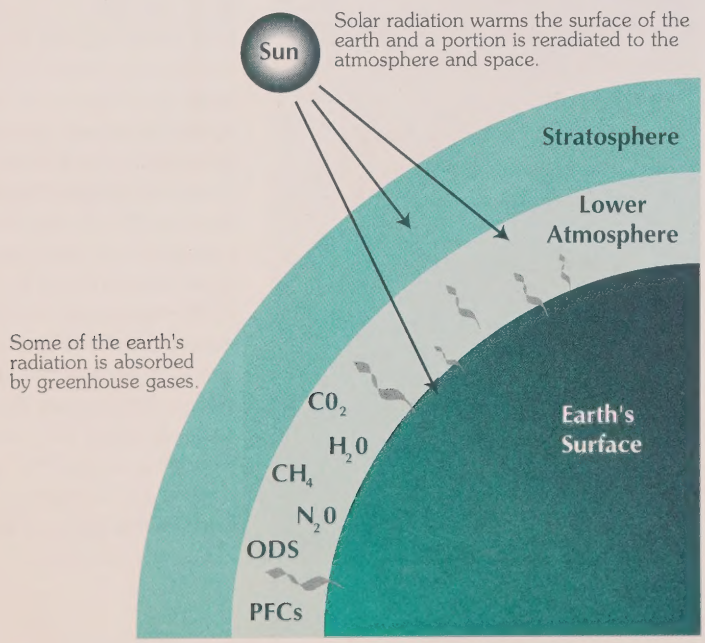
## The Greenhouse Effect

The greenhouse effect is a natural process essential to maintaining the earth's climate and ecosystems. Several important greenhouse gases (GHGs) allow solar radiation to pass through to the earth's surface, where it is absorbed, and then trap some of the energy radiated back into the atmosphere. If not for these gases, our planet would be a frigid, lifeless world (about 33°C colder). They keep the earth's surface and lower atmosphere comfortably warm—with a global average surface temperature of 15°C—and ensure proper moisture levels.

## Human-Caused Greenhouse Gases

Since the Industrial Revolution, human activities have increased the atmospheric concentration of greenhouse gases. Current scientific evidence suggests that these increased concentrations will enhance the greenhouse effect, further warming the earth's surface.

Carbon dioxide ($CO_2$) accounts for more than half of this enhanced greenhouse effect, released mainly by the burning of fossil fuels and permanent deforestation. Methane ($CH_4$) is another major contributor, produced largely in rice paddies, livestock and landfills. Perfluorocarbons (PFCs), nitrous oxide ($N_2O$), and ozone-depleting substances (ODS) are emitted in small amounts, but remain for a long time in the atmosphere. [ODS, such as chlorofluorocarbons (CFCs) and halons, are excluded from this action plan, since their international phase-out is covered under the Montreal Protocol.] Water vapour ($H_20$) is the most abundant greenhouse gas, but our activities do not directly affect it.




*The Greenhouse Effect traps reradiated heat in the earth's lower atmosphere.*

*This action plan addresses all major greenhouse gases except ozone-depleting substances covered under the Montreal Protocol.*

Sources: IPCC (1994) and BOVAR-CONCORD et al. (1994)

## Major Greenhouse Gases[1]

| Gas | Lifetime | GWP[2] | Warming[3] | Key Sources |
|---|---|---|---|---|
| **Carbon Dioxide** ($CO_2$) | 100-200 yrs | 1 | 66% | Thermal power generation; transportation; home heating; other fossil fuel combustion; deforestation; natural biomass decay |
| **Methane** ($CH_4$) | 11 yrs | 25 | 15% | Natural gas production and use; livestock; rice paddies; landfills; biomass burning; wetlands |
| **Nitrous Oxide** ($N_2O$) | 120 yrs | 320 | 3% | Motor vehicles; chemical and industrial operations; other fossil fuel combustion; natural vegetative processes |
| **Perfluorocarbons** (PFCs) | 10 000-50 000 yrs | 6 000–12 500 | <1% | Aluminum smelting |

[1] Excludes CFCs, halons and other ODS covered under the Montreal Protocol.
[2] Global warming potential over 100 years, relative to $CO_2$.
[3] Estimated contribution to global warming over the past century. Total does not sum to 100% because of excluded gases.

### Comparing Greenhouse Gases

*Greenhouse gases make different contributions to global warming depending on:*

- *Atmospheric lifetime before a gas is destroyed or absorbed; and*
- *Global warming potential (GWP), or capacity of a gas to absorb and reradiate heat energy over a fixed period of time (e.g. 100 years), expressed as potency compared molecule for molecule with $CO_2$.*

*Although $CO_2$ is the least effective GHG, we release much more of it than any other gas. Therefore, its contribution to global warming has been the largest of human-caused GHGs over the past century.*

## GHGs and Global Warming

Since the 1980s, various climate models have considered the impact of a doubling of $CO_2$ concentrations from pre-industrial levels sometime in the next century. In its upcoming second scientific assessment (currently in draft form), the Intergovernmental Panel on Climate Change (IPCC) estimates that such a concentration could increase average global temperatures by 0.8°C to 3.5°C by 2100—amounting to only 50-70% of the expected eventual warming. To put these figures in perspective, the earth's average surface temperature during the last ice age was only about 5°C colder than today. According to the IPCC's best estimate, an average 2.5°C warming could cause sea levels to rise by some 46 centimetres.

### Intergovernmental Panel on Climate Change (IPCC)

*The IPCC is an intergovernmental body created in 1988 to report to the United Nations and the World Meteorological Organization on the state of knowledge with respect to climate change and its impacts. The panel brings together leading world scientists through three working groups on the science of climate change, impacts on the natural environment, and the socio-economic effects of mitigation and adaptation. Its first assessment report was published in 1990, with the second assessment report soon to be released. Canada co-chairs Working Group III on the socio-economic dimensions, and contributes to the writing and review of all IPCC reports.*

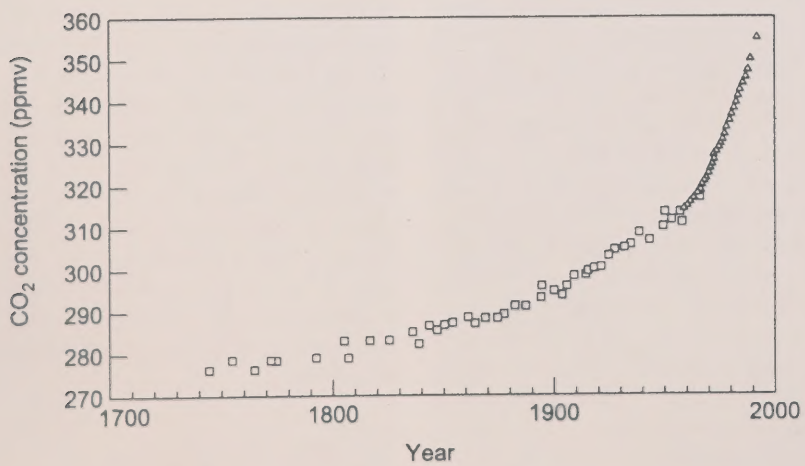
## Global Warming and Climate Change

The IPCC and other members of the scientific community are increasingly confident that global warming will lead to global climate change—major alterations in weather systems at at pace unprecedented in the planet's history. The debate now centres on how great and fast the change will be, how it will affect different natural systems and regions of the world, and what can be done to avert it. Global climate change on the scale predicted by the IPCC would mean disruptions in regional patterns of rainfall and drought, increased severity of storms, rising sea levels and temperatures, and extensive flooding of low-lying coastal areas. This, in turn, would affect many aspects of our natural environment, economy and society unable to adapt to the rate and extent of climate change—including arable land, human health, political stability, resource management and physical infrastructure.

## Climate Change Impacts in B.C.

Some climate models suggest a rise in average temperature over the next 100 years of 2°C to 4°C in southern Canada, and even higher in the North. Preliminary estimates for B.C. put the average temperature increase at 7°C in winter and 4°C in summer, with an uncertainty of 3°C (McBean et al. 1992). The West Coast will likely get more rain, especially in the winter months. The Interior will likely get less, which could lead to more frequent drought and forest fires, and greater demands on local water resources. A global rise in sea level could cause major coastal flooding and erosion, wiping out important estuaries and damaging property, dikes and aquaculture.

Such effects could create significant problems for B.C.'s natural resource sectors, notably forestry and fisheries. Animal and plant species and habitat could be threatened.

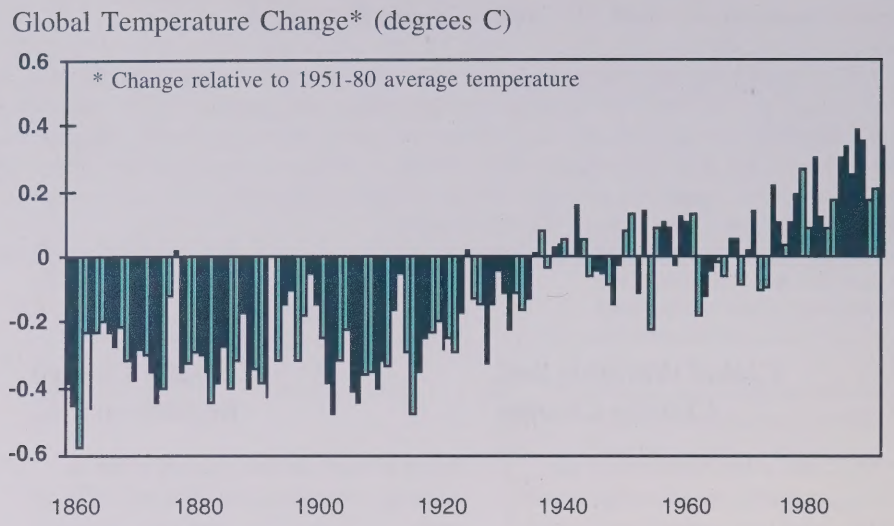



*Concentrations of $CO_2$ in the atmosphere have risen dramatically over the last 100 years (ppmv = parts per million by volume).*

Source: Houghton (1994)

*During the past century, the 10 warmest years have occurred since 1980.*

Source: Hansen and Lebedeff (1995)




Salmon stocks could be reduced by higher water temperature, lower water salinity, and altered currents in the ocean and streams. Current forest zones are expected to shift northward and to higher elevations. In addition, B.C. forests could become more vulnerable to pests, disease and fire.

## The Scientific Debate

Our climate is determined by the complex interaction of oceans, land masses, cloud feedbacks and other variables. As predictive tools, climate change models are far from perfect, and their results are widely debated. The observed warming of the earth's surface is at the upper limit, but still within the range of normal climate variability. However, in its draft second scientific assessment, the IPCC finds that "the best evidence to date suggests that global mean temperature changes over the last century are unlikely to be entirely due to natural causes, and that a pattern of climatic response to human activities is identifiable in the climatological record" (IPCC 1995a).

### Has Global Warming Already Begun?

*There are indications that the warming trend may have already started. In the last 100 years, the average temperature of the earth's surface has increased by 0.3°C to 0.6°C, and sea levels have risen by 10 to 20 centimetres. The 10 warmest years in the period have all taken place since 1980. Also, there have recently been a number of extreme and damaging climate events across the globe, including flooding in Europe and the United States, severe hurricanes and tornadoes, and major droughts.*

## Reducing the Risk

Many countries, including Canada, recognize that the scientific debate should not be used as an excuse to delay mitigative action. The risks are simply too great. If climate change is substantial, and nothing is done to avert it, some damage will be irreversible and future mitigation may be more expensive. Assuming that we can simply adapt to climate change is not an acceptable response, given the potential costs of famine, drought, coastal flooding and other global impacts. While some adaptation is likely necessary, reducing the risk of climate change requires taking mitigative action now.

## Some Definitions

***Mitigation*** *refers to actions that reduce emissions or enhance sinks, to avoid the impacts of future climate change. The adoption of energy efficient and less GHG-intensive, renewable energy technologies are examples of mitigative measures.*

***Adaptation*** *means anticipating and adjusting to future climate change. Examples of adaptive measures are increasing water storage in drought-prone areas and raising dykes to protect against flooding.*

*A* ***sink*** *is a natural reservoir for absorbing and storing GHGs. Soils, plants and ocean plankton act as sinks for $CO_2$.*

*An* **offset** *is a measure that compensates for increased emissions from one source by reducing emissions from another source, or by increasing sinks. Tree planting is counted as an offset to some countries' fossil fuel emissions.*

## Action to Mitigate GHGs

There are a wide variety of ways to reduce greenhouse gases, and a smaller number to enhance their absorption from the atmosphere. Because these gases are emitted mainly from the burning of fossil fuels, many reduction measures are related to energy use and production. Energy-related emissions can be reduced by:

- conserving and using energy more efficiently;
- switching to less GHG-intensive and GHG-free fuels; and
- developing and implementing new technologies that lower GHG emissions.

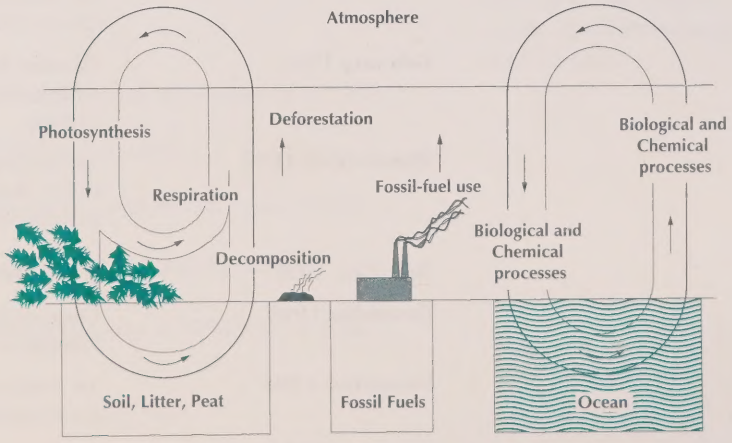
Because landfills are a major source of methane, cutting solid waste is another important emission reduction measure.

We can also maintain and enhance the world's natural "sinks" for GHGs, through forestry and agricultural practices. While it is difficult to quantify the flows of $CO_2$ between the earth's atmosphere, oceans, soils, vegetation and animal life, sustainable management of our forests and soils can contribute to the natural carbon balance. International agreements have recognized "afforestation"—tree planting on previously unforested areas—and other sustainable resource practices as legitimate "offsets" to the emissions from fossil fuel combustion.

Many of these preventative actions are cost-effective, resource efficient and worth doing for other reasons—for example, to save money, improve local air quality and, more

### The Global Carbon Cycle

*There is a finite supply of carbon in the earth's air, oceans, rocks and soils, vegetation, animal life and fossil fuels. Through photosynthesis, plants take $CO_2$ from the atmosphere, some of which is then released when plants and animals die and decay. Soils and trees are among the natural reservoirs for storing or "sequestering" carbon. At times, these reservoirs act as net carbon sinks, absorbing more $CO_2$ than they release; at others, they become net carbon sources. Overall, the natural cycling process removes as much carbon as it adds. Human activities, particularly fossil fuel combustion and deforestation, are altering this cycle and returning stored $CO_2$ so rapidly to the atmosphere that natural processes do not have time to absorb it.*




Source: California Energy Commission (1991)

generally, work towards sustainable development. This suggests a "no regrets" response to the risk of climate change, targeting lower cost actions first, while continuing to evaluate the growing scientific evidence and the need for more costly mitigation.

## International Action

Since the 1992 Earth Summit in Rio de Janeiro, more than 140 countries have ratified the international Framework Convention on Climate Change (FCCC), which took effect in March 1994. The FCCC commitment addressed the need to stabilize atmospheric concentrations of greenhouse gases "at a level that would prevent dangerous anthropogenic interference with the climate system". While the commitment did not set target emission levels or dates, industrialized nations have generally interpreted it to mean stabilization of national GHG emissions at 1990 levels by the year 2000. Countries have adopted different positions and policies for GHG management, with Canada and the U.S. favouring voluntary, market-based actions by government, industry and citizens at large.

At the first Conference of the Parties to the Convention in the spring of 1995, countries presented action plans, as well as sta-

### Stabilizing GHGs: Concentrations vs. Emissions

*According to the IPCC, atmospheric **concentrations** of long-lived greenhouse gases adjust very slowly to changes in **emissions**. As a result, if we continue emitting these gases at current rates, their concentrations will likely rise for hundreds of years. The IPCC has estimated that it would take an immediate 60% reduction in global emissions to stabilize $CO_2$ concentrations at today's levels (IPCC 1990). Methane would require a 15-20% emission reduction for its atmospheric concentrations to be stabilized.*

*B.C.'s GHG Action Plan is part of a series of national and international events.*

## A Chronology of Key Events

| Date | Event/Outcome |
|---|---|
| **June 1988** | The Changing Atmosphere Conference, Toronto—Toronto target set at 20% reduction from 1988 levels by 2005 |
| **June 1992** | United Nations Conference on Environment and Development, Rio de Janeiro—Framework Convention on Climate Change (FCCC) |
| **February 1995** | Canadian Energy & Environment Ministers' Meeting, Toronto —Ministers endorse National Action Program on Climate Change |
| **March–April 1995** | 1st Meeting of the Conference of the Parties to the FCCC, Berlin—Berlin Mandate to negotiate post-2000 commitments |
| **July–Oct. 1995** | B.C.'s GHG Action Plan consultations—Plan developed |
| **November 1995** | Canadian Energy & Environment Ministers' Meeting, Edmonton—Tabling of B.C.'s Action Plan |
| **December 1996** | 1st National Review of Progress to Date—Canadian governments and industry report on progress |
| **Summer 1997** | 3rd Meeting of the Conference of the Parties to the FCCC, Japan—Protocol signed on post-2000 commitments |

tus reports on their greenhouse gas emissions and progress towards national goals. The conference's main outcome, the Berlin Mandate, acknowledged that the FCCC commitment was inadequate and agreed to establish a negotiating process for strengthening it beyond the year 2000. Agreement was also reached on a pilot phase of joint implementation, whereby one country could meet its obligations partly by reducing emissions or increasing sinks in another country. Negotiations are going ahead to develop a protocol on post-2000 commitments and actions by 1997.

## National Action

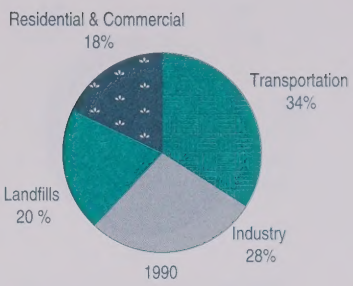
In February 1995, Canada's environment and energy ministers agreed to "proceed with the development of options that will meet Canada's current commitment to stabilize GHG emissions at 1990 levels by the year 2000, and develop sustainable options to achieve further progress in the reduction of emissions by the year 2005 (Communique)." They approved the National Action Program on Climate Change (NAPCC), which was presented in Berlin two months later. It was understood that the measures outlined in the program would not be enough to meet Canada's stabilization goal.

Without additional action, Canada's year 2000 emissions are expected to be in the range of 645 to 655 megatonnes of $CO_2$-equivalent, 13% higher than 1990 levels. The national program presents individual jurisdictions, industry and the public with options, and leaves them to select, commit to and implement specific GHG reduction measures. Energy and environment ministers agreed to report on their evaluation of a full range of options at their next joint meeting on November 20,1995.

## Provincial Action

Besides actively supporting the federal target, B.C. is the only jurisdiction in Canada that has committed to the goal of stabilizing provincial GHG emissions at 1990 levels by the year 2000. We were also the first to complete province-wide inventories quantifying emissions and outlining options for their management. Over the past four years, the provincial government has held a series of consultations on GHG issues, in partnership with the federal and regional governments.

In 1994, the province began work on a greenhouse gas management strategy. A package of public and private sector actions to reduce GHG emissions has since been assembled in consultation with




*Transportation makes up more than one-third of provincial GHG emissions.*

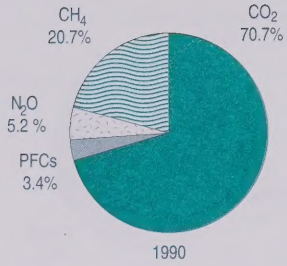
Source: B.C. Ministry of Environment, Land and Parks (1992)

## International Climate Change Commitments

*Countries, for reasons of their own, have chosen different goals for reducing GHG emissions.*

| Country | Specified Goal[1] |
|---|---|
| **Australia** | Stabilize net GHGs at 1988 levels by 2000; reduce 20% by 2005 |
| **Canada** | Stabilize net GHGs at 1990 levels by 2000 |
| **Germany** | Reduce gross $CO_2$ from energy sector to 1987 levels by 2005 |
| **Japan** | Stabilize per capita gross $CO_2$ at 1990 levels by 2000 |
| **Sweden** | Stabilize gross $CO_2$ from energy sector at 1990 levels by 2000; reduce beyond 2000 |
| **United States** | Stabilize net GHGs at 1990 levels by 2000 |

[1]Net emissions defined as gross emissions less absorption by sinks




*$CO_2$ accounts for the majority of B.C.'s GHG emissions.*

Source: B.C. Ministry of Environment, Land and Parks (1992)

government, industry and the general public. This B.C. Greenhouse Gas Action Plan was submitted at the November 20th meeting of Canada's energy and environment ministers.

## Local Action

Several Canadian cities—including Montreal, Toronto, Edmonton, Vancouver and Victoria—have made commitments to reduce GHG emissions by 20% from 1988 (1990 for Vancouver) levels by 2005. Since 1990, both the Vancouver and Victoria municipal governments have conducted public consultations to identify options for managing local $CO_2$ emissions. The Greater Vancouver Regional District (GVRD) has produced a greenhouse gas inventory for the year 1990, and has included global climate change as one of the priority issues in its Air Quality Management Plan. In addition, other B.C. communities are taking measures that reduce their GHG emissions, as reported later in this action plan.

### The Global Commons: Why Act?

*Our atmosphere is part of the "global commons," owned by no individual, company or country. As a result, the contribution of any one jurisdiction to reducing greenhouse gases will be inconsequential, unless all jurisdictions act together. The Framework Convention on Climate Change recognizes this dilemma, and compels all signatories to act. While there will inevitably be leaders and followers in climate change policy, waiting to see if other countries take action is not an acceptable response.*

## B.C.'s GHG Emissions

B.C. accounts for about 10% of Canada's GHG emissions, and 0.2% of the global total. On a per capita basis, however, our emissions rank among the highest in the world. In 1990, B.C. emissions of $CO_2$ from non biomass sources, methane, nitrous oxide and PFCs were estimated to

## International Positions on GHG Management

*There are wide-ranging views among developed and developing countries on greenhouse gas policies.*

| Jurisdiction | Position/Focus of Activities |
|---|---|
| **JUSCANZ**[1] countries | Voluntary, market-based measures by the public and private sectors; technological improvement |
| **Scandinavia** (e.g. Denmark and Sweden) | Aggressive GHG reduction targets; emphasis on regulatory measures, taxes and subsidies |
| **Developing countries** (e.g. China and India) | No action planned at this time; waiting for industrialized countries to lead by example |
| **OPEC**[2] | Petroleum producing nations resisting action on climate change; deny scientific evidence |
| **AOSIS**—Alliance of Small Island States | 43 countries most threatened by sea level rise; calling for 20% reduction in global emissions by 2005 |

[1] Japan, U.S., Canada, Austrialia and New Zealand
[2] Organization of Petroleum Exporting Countries

total 58 megatonnes of $CO_2$-equivalent. Two-thirds of these emissions came from transportation and industry, with the remainder from landfills and the residential and commercial sectors.

The outlook for B.C.'s emissions depends mostly on future trends in fossil fuel production and use. Continuing strong population and economic growth is expected to increase the demand for energy. Unless substantial efforts are made to reduce energy consumption or switch to less GHG-intensive energy sources, the majority of this increased demand will be met by conventional fossil fuels (oil products and natural gas). In the absence of further action, provincial emissions are forecast to grow to about 63.8 megatonnes of $CO_2$-equivalent, 10% higher than 1990 levels.

## A Growing Economy

How can we hope to stabilize greenhouse gas emissions and, at the same time, accommodate growing population and production levels? Although growth creates demand for more energy services—and may result in more fossil fuel emissions—history has shown that economic activity, energy use and emissions are not inextricably linked. During the 1980s, B.C. became more energy efficient and less reliant on oil. Provincial output grew by more than 30%, while greenhouse gas emissions grew by less than 5%. Thus, reducing provincial emissions is not inconsistent with maintaining economic growth.

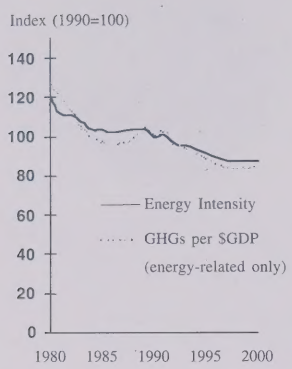
### Voluntary Challenge and Registry

*Canadian industry has asked for a voluntary approach to GHG management, which would allow it to find the most cost-effective emission reduction measures, rather than relying on government regulation. Government has responded with the Voluntary Challenge and Registry Program, a major component of the national action plan. This program challenges Canadian industry associations, individual corporations and major municipalities to implement GHG emission reduction measures. A national registry will record commitments and emission reductions, monitor progress and reward achievement. Participants began submitting action plans in late September 1995.*

## Economic Impacts of GHG Management

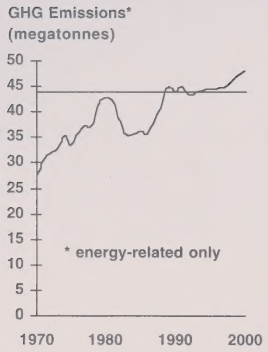
While emission reduction does not mean shutting down the provincial economy, it does require improvements in energy efficiency. Energy conservation and efficiency are part of a no regrets strategy, in that they provide positive impacts on the economy through lower energy costs and increased competitiveness. As part of its second assessment, Working Group III of the IPCC has been evaluating the costs and benefits of greenhouse gas mitigation measures. The group reports that perhaps 10% to 30% of current energy use can be saved at little, if any, cost—what it calls the "no regrets energy efficiency potential" (IPCC 1995b).

Not surprisingly, studies of the economic impact of GHG reduction that have emphasized the role of energy efficiency have generally concluded that the impact of mitigation on total national and provincial output would be negligible or even slightly positive. A recent analysis of mitigation scenarios developed for the National Action Program concluded that there would be an increase in B.C.'s GDP of 0.5% by the year 2000 (Infometrica 1995). However, other studies have shown net reductions in GDP of similar magnitudes, so that the likely economic impacts remain uncertain.




*B.C has reduced emissions and become more energy efficient, while our economy has grown.*

Source: B.C. Ministry of Energy, Mines and Petroleum Resources




*Since 1990, B.C.'s GHG emissions have remained relatively stable, but are forecast to be about 10% higher by 2000 without further action.*

Source: B.C. Ministry of Energy, Mines and Petroleum Resources

## Action Taken to Date

Government, industry and the public have already taken measures that support B.C.'s stabilization goal, by slowing the growth in greenhouse gas emissions. In general, these efforts were not made with the intent of reducing emissions or enhancing sinks. Nonetheless, GHG management has emerged as a secondary benefit. Actions taken to date include:

- Power Smart and other energy conservation and efficiency programs;
- provincial energy efficiency standards and codes for equipment and buildings;
- industrial process changes and increased use of biomass fuels (wood residue);
- fuel switching from oil to natural gas via the Vancouver Island Pipeline;
- new biomass energy facilities at Williams Lake and Howe Sound;
- the Forest Renewal Plan, Forest Practices Code and other resource management initiatives;
- the AirCare vehicle emissions inspection and maintenance program;
- Go Green and other programs to encourage alternative transportation modes; and
- Canada's largest per capita fleet of alternative fuel (propane and natural gas) vehicles.

### Energy Intensity and GHG Emissions Per Unit Output

*Energy intensity is a measure of energy use per unit of output, and is often expressed as energy consumed per dollar of Gross Domestic Product (GDP). Largely due to our energy-intensive resource-based industry, B.C. is one of the world's heaviest energy users, and thus greenhouse gas emitters. Since 1980, energy per $GDP has declined by 23%, and GHG emissions per $GDP have fallen by 27%. These trends reflect energy efficiency improvements, as well as a structural shift in the economy from resource industries to less energy-intensive manufacturing and services.*

## Reaching the Target

The combined effect of these actions will reduce the forecast growth in B.C.'s emissions by almost 3% between 1990 and the year 2000. Still, total emissions are expected to be approximately 5.8 megatonnes (10%) above their 1990 levels by the end of the decade. The measures described in this action plan will make considerable progress towards reducing the growth in GHG emissions, but are unlikely to cut that growth to zero, without additional effort from all sectors.

Our challenge is to find the right mix of actions and players to achieve provincial stabilization of emissions. All sectors of society emit greenhouse gases, from homeowners to vehicle users, to factories, businesses and government offices. Consequently, everyone can play an important role in managing these emissions now and into the next century.

# The Approach

The B.C. Greenhouse Gas Action Plan is the province's first report on measures that are being taken to reduce GHG emissions. The plan is a "living" document in that many provincial actions are already underway; furthermore, it will continue to evolve as we learn more about the benefits and costs of emission reduction options. The actions underway, development of the plan, and its future evolution are all positioned within the province's overall strategic plan, which sets out provincial values and priorities. As well, the choice of actions and policy measures is guided by a set of principles specific to climate change.

## Provincial Values and Priorities

The B.C. government's overall strategic plan contains the fundamental value of sustaining the environment and communities. Greenhouse gas management, and adaptation to climate change, are essential to long-term sustainability both globally and at home. In addition to supporting international commitments, the development of B.C.'s Greenhouse Gas Action Plan serves the objectives of:

- a broader Clean Air Strategy being implemented to address the province's major atmospheric concerns;
- a 1992 recommendation by the B.C. Round Table on the Environment and the Economy calling for a provincial no regrets GHG reduction strategy; and
- the B.C. Energy Council's 1994 Energy Strategy, which recommends a proactive approach of more than 50 actions providing greenhouse gas benefits.

Many of the government's other key priorities and initiatives have implications for GHG emissions and their management. These include activities in parks and wilderness preservation, sustainable forestry and agriculture, land use planning, control of urban growth, transportation infrastructure, building construction, energy supply and municipal waste management.

Future emissions depend to a large extent on government actions affecting the sectors that emit or absorb greenhouse gases. B.C.'s action plan contains a number of these initiatives, such as the provincial Transportation Strategy, Forest Renewal Plan and *Growth Strategies Statutes Amendment Act*. It is also aligned with the province's jobs and investment strategy, *Investing in our Future: A Plan for B.C.*, which continues a three-year commitment to no new taxes or tax increases.

## Policy Options

Every day, British Columbians make millions of choices that involve the use of energy and the production of greenhouse gases. Governments can influence those choices through a number of different policy levers or instruments:

- information and education on technological and behavioural changes;
- moral suasion and leadership by example;
- research and development to introduce new technologies;
- legislation and regulation (e.g. energy efficiency and vehicle emission standards);
- taxes, tradeable emission permits and other economic instruments; and
- financial incentives and financing mechanisms.

The B.C. Greenhouse Gas Action Plan contains actions or options in all of these categories. When deciding on specific actions, the province is guided both by the provincial priorities set out above and by a set of policy principles.

## Guiding Principles

The principles underlying this action plan build on those in Canada's National Action Program on Climate Change:

**Precautionary Principle**
*Given the potential damage from climate change, the lack of scientific certainty does not justify postponing mitigation that is cost-effective or worth doing for other reasons.*

**Shared Responsibility**
*All levels of government, the private sector and the public must take action to manage greenhouse gases.*

**Comprehensiveness**
*The action plan should address all gases not covered by the Montreal Protocol, from a long-term management perspective, and in the wider context of other atmospheric and environmental problems.*

**Competitiveness**
*The plan should emphasize actions that are cost-effective and ensure domestic job creation and competitiveness abroad.*

**Accountability**
*The various players must make commitments to achieving GHG reductions, and their progress and achievements must be monitored and reported.*

**Flexibility**
*The plan should evolve over time to reflect changing technology, scientific knowledge and experience with climate change and its mitigation.*

**International Cooperation**
*GHG management requires a global effort that stresses leading by example and partnerships with other countries.*

As well as these common principles, B.C.'s plan is guided by:

- *the selection of GHG management measures that meet the government's debt management plan and other fiscal constraints;*
- *adoption of measures whose benefits, broadly defined—environmental, social and economic—exceed the associated costs to British Columbians; and*
- *adherence to the "polluter pay" principle, whereby all emitting sectors should be held accountable for their fair share of the reduction in greenhouse gases.*

## B.C.'s Approach

Our approach to greenhouse gas management, guided by the above values, priorities and principles, recognizes that:

- emphasis should be placed on the early implementation of no regrets actions, such as energy efficiency, that are cost-effective and worth doing anyway;
- voluntary action is effective and critical, and the Voluntary Challenge and Registry Program should be supported;
- voluntary action alone may not achieve the necessary reduction in provincial emissions; and
- further measures, including fiscal and regulatory ones, may also be needed, but must first be carefully evaluated.

# The Process

This action plan has been prepared by the Ministry of Energy, Mines and Petroleum Resources and the Ministry of Environment, Lands and Parks in consultation with the Ministries of Agriculture, Fisheries and Food; Employment and Investment; Forests; and Transportation and Highways. Broader input into the plan was obtained through a series of consultations with industry, different levels of government, environmental groups and other stakeholders.

## History of Consultation

B.C. has held a number of consultations focused entirely or partly on greenhouse gas issues. These include a Climate Change Workshop in May 1992 and the federal-provincial Climate Change Outreach Session in October 1994.

The most extensive consultative process to date was implemented for the B.C. Energy Council's (BCEC's) Energy Strategy released in November 1994. Over a four-month period, the Energy Council distributed 6,000 copies of its draft strategy, held town hall meetings and discussions with stakeholder groups, and received hundreds of written, faxed and telephone submissions. The resulting report contains 65 recommendations on how to move towards energy sustainability, many of which also target GHG reduction (BCEC 1994). Already, the government has begun to act on almost half of the Council's recommendations, in part through policies and programs described in this action plan.

## The Action Plan Consultations

Between July and the end of September 1995, the two lead ministries conducted public consultations to obtain stakeholder input on the content of B.C.'s GHG Action Plan. The objectives of the consultations were to:

- *achieve agreement in principle to take action on managing GHG emissions;*
- *identify measures for reducing emissions or enhancing sinks;*
- *learn about commitments that stakeholders have made for the national Voluntary Challenge and Registry;*
- *identify barriers to success, and actions to overcome those barriers;*
- *list options for emission monitoring and reporting; and*
- *list indicators for tracking achievement and acknowledging success.*

The consultation process was divided into two parts: (1) a series of focused discussions with key sectors, and (2) an invitation to a wider group of stakeholders for written comments. Key sectors were defined as those that are significant sources of GHG emissions and/or potential GHG sinks: transportation; utilities and pipelines; "upstream" energy supply; pulp, paper and wood products; forestry and agriculture; other industry (cement, lime, chemical, mineral and metal producers); and government. The wider solicitation went to environmental groups, industry associations, First Nations, federal agencies, and other organizations and individuals.

Seven focus group meetings were held in August and September 1995. According to feedback received, the meetings provided a valuable opportunity for organizations to express their interests and exchange information. Participants asked for continued involvement in the action plan's development and implementation.

Findings from the consultations are reported in a separate appendix entitled, *B.C. Greenhouse Gas Action Plan Public Consultation Process.*

# The Plan

The B.C. Greenhouse Gas Action Plan calls on all major contributors to greenhouse gases to take responsibility for reducing their emissions. More than 50 actions that the province has decided to undertake or evaluate are outlined below. In addition, the plan documents many significant steps being taken by other levels of government, industry and the public, and provides examples of further GHG reduction measures that could be adopted.

Included in the action plan are seven options for further development, analysis and consultation. Among them are measures that could substantially reduce emissions, such as requiring transportation fuels to be produced partly from renewable sources. Some of the options would be controversial, or could have significant economic impacts on certain sectors. Consequently, government is committed to evaluating these measures over the next several years, and to consulting widely before any decisions are made to proceed. The options are included here to demonstrate the kinds of measures that may have to be taken if sufficient progress is not made towards GHG stabilization through public and private sector voluntary action.

## Provincial Leadership

The public sector is itself a source of greenhouse gases, primarily from energy use in vehicles and buildings. If British Columbians are to be convinced of the commitment to stablize GHG emissions, government must show leadership in environmental responsibility and efficient energy use. The province is developing leadership actions as part of a broader "Greening Government" initiative. More generally, all players—government, industry and the public—can set an example by demonstrating that emissions can be reduced cost-effectively for their individual sectors.

### 1. Develop an Energy Efficient Public Buildings Program to encourage energy retrofits in existing public facilities.

Provincially funded facilities in B.C. spend over $120 million each year on energy. The BC Buildings Corporation (BCBC) has already made significant energy efficiency improvements in government offices, reducing average energy use by 55% since 1978 and saving B.C. taxpayers some $7 million annually. Energy upgrades of other public facilities—including schools, colleges and universities, hospitals and social housing—could reduce their annual energy consumption by 10-20%.

Despite the potential for reducing operating costs, financing energy retrofits out of limited capital budgets is difficult for government agencies. One solution is to use energy service companies that provide financing, as well as retrofit the building (energy performance contracting). This approach has been taken by Natural Resources Canada (NRCan) in its Federal Buildings Initiative, and is now being adapted by several provinces. The Ministry of Energy, Mines and Petroleum Resources will work with BCBC, NRCan and other provincial agencies to develop an Energy Efficient Public Buildings Program for B.C.

#### Energy Performance Contracting

*Under energy performance contracting, homeowners or building managers contract with energy service companies (ESCOs) who secure financing and perform energy retrofits. To recover their up-front capital costs and service fees, the ESCOs are then repaid by taking a portion of the guaranteed future savings in energy bills. This provides a source of capital for energy efficiency improvements while, at the same time, ensuring that customers pay the same or lower energy bills.*

## What Government and Universities are Doing

In April 1995, B.C.'s colleges and universities issued environmental guidelines for new building design of post-secondary facilities. These innovative guidelines include life cycle costing, a 50% energy savings target, environmentally conscious building design, and regular "report cards" on energy use for building managers.

The Jack Davis Building, which houses the Ministry of Energy, Mines and Petroleum Resources in Victoria, won a 1993 Power Smart Award of Excellence for energy efficient design and construction. Through May 1995, the building's energy costs were 37% lower than comparable downtown office structures.

The B.C. Systems Corporation's pioneering telecommuting pilot begun in 1992 demonstrated space savings, improved productivity, and reduced fuel use and emissions. It is estimated that if 10% of government employees were to telecommute, almost 3 800 tonnes of GHGs could be saved annually.

**2. Immediately adopt the provisions of the draft B.C. Energy Code for all new public buildings, and evaluate a higher energy efficiency target in 1997.**

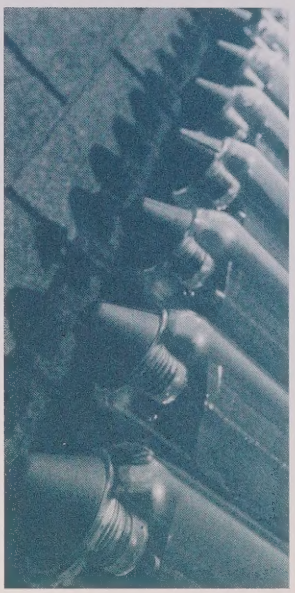
A new energy code for buildings is planned for implementation in 1997. The draft B.C. Energy Code, which is based on the National Energy Code for Buildings, has been developed by the Ministry of Energy, Mines and Petroleum Resources in consultation with industry stakeholders. The B.C. government will adopt the Energy Code early for its own buildings, by requiring that all new provincially funded buildings meet the code starting in 1996. Furthermore, once the Energy Code is adopted into the B.C. Building Code in 1997, the government will evaluate whether to set higher energy efficiency standards for provincially funded buildings. Experience with the Jack Davis Building has shown that efficiency levels 30% better than the draft B.C. Energy Code can be achieved with products and technologies available in today's marketplace.

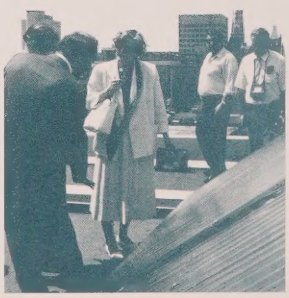
**3. Adopt a government wide minimum energy efficiency standard for new office equipment.**

Computers, faxes, photocopiers and other office equipment contribute up to 40% of government's electricity costs, when air conditioning to cool the equipment is counted. New desktop computers, monitors and printers purchased by B.C. will meet the U.S. Environmental Protection Agency's "Energy Star" standard. Using power-down and other efficiency features, Energy Star products can reduce computer energy use by 60–70%. The B.C. Purchasing Commission estimates that the government's annual power costs could be reduced by as much as 10%, as new computer systems replace old ones. Purchasing standards will likely be extended to faxes and photocopiers, as well. Office equipment will also be considered for mandatory minimum efficiency regulation under the provincial *Energy Efficiency Act*.

**4. Evaluate opportunities for solar water heating and other renewable energy technologies in public facilities, on an ongoing basis.**

Already, there are successful applications of these technologies. For example, B.C. Hydro, BC Tel and the Ministry of Transportation and Highways use solar-powered communications at remote sites around the province. BCBC has developed procedures for screening and evaluating the feasibility of solar energy applications. To raise the profile of such technologies, the government will examine the potential for solar water and air heating, solar power, ground source heat pumps, and building orientation for passive solar in the construction of new public facilities. The use of fossil fuel generators, especially in remote areas, will be reviewed for possible replacement by solar, wind or micro-hydro power.





*An evacuated heat-pipe solar collector tube system at the B.C. Archives building in Victoria generates emissions-free energy for water heating.*

### What Industry is Doing

Energy utilities and pipeline companies are leaders in signing onto the national Voluntary Challenge and Registry—including Alberta Natural Gas, BC Gas, B.C. Hydro, Centra Gas, Foothills Pipelines, Pacific Coast Energy, Pacific Northern Gas, TransMountain Pipeline and Westcoast Energy.

The Canadian Association of Petroleum Producers (CAPP) expects that 90% of oil and gas producers will participate in the Voluntary Challenge. Among its efforts, CAPP has prepared a detailed guide to help member companies meet the challenge, with information on emission reduction measures, company success stories, and indicators for tracking progress.

The Canadian Gas Association's 1990 inventory of GHG emissions will provide a baseline against which to measure the natural gas industry's progress towards reducing emissions.

**5. Institute guidelines to promote the purchase of more fuel efficient vehicles and cleaner burning fuels for the provincial fleet.**

The B.C. government fleet has decreased by almost one-third over the past decade. Currently, about 5% of the 5 300 cars and light duty trucks are capable of operating on alternative fuels. The province has prepared a Government Fleet Purchase Policy to reduce the fleet size and encourage the selection of smaller, more fuel efficient vehicles. Guidelines are also provided for the purchase of alternative fuel vehicles, including zero emission vehicles (e.g. electric cars). In addition to these actions, the policy promotes more conscientious use of the existing fleet, by discouraging single occupant vehicle use and encouraging trip reduction. The new guidelines, to take effect immediately, challenge government employees and other B.C. fleet purchasers to match the province's commitment.

**6. Expand transportation demand management initiatives, including telecommuting, for provincial government and Crown corporation employees.**

Transportation demand management (TDM) covers a broad spectrum of measures aimed at changing travel behaviour to make better use of existing facilities. It encompasses measures ranging from public education, to incentives and regulations that encourage travellers to:

- shift from single occupant vehicles to carpools, transit, cycling or walking;
- shift from peak to off-peak travel times; and
- reduce the number and/or length of trips.

Provincial ministries and Crown corporations have been involved in a variety of TDM initiatives, including the Go Green campaign, Jack Bell Foundation vanpooling, flex-time policy and telecommuting pilot projects. Each ministry has appointed an Employee Transportation Administrator who must develop a TDM plan. Transportation Demand Management for government and Crown employees will be expanded under the umbrella of a province wide initiative being led by the BC Transportation Financing Authority (Action 20).

**7. Launch an employee Environmental Awareness Program, as part of the Greening Government initiative.**

Employees can initiate their own emission reduction measures, in the way they travel to and from work, operate equipment at the office, recycle materials and so on. Over the next two years, the Ministry of Environment, Lands and Parks will develop an environmental awareness program for government and Crown corporation employees. This program will be accompanied by awards for innovative employee efforts to save energy and decrease the consumption of fossil fuels.

**8. Evaluate options for introducing zero emission vehicles (ZEVs) to B.C.**

Success Stories

### What Industry and Government are Doing

Recently, BC Gas won an award from the American Gas Association for its use of natural gas vehicles (NGVs). BC Gas has converted about 90% of its vehicle fleet capable of conversion to natural gas.

BC Transit has bought 25 natural gas buses from New Flyer of Winnipeg, to test the viability of NGV technology for mass transit, and is considering the purchase of low-floor buses powered by Ballard hydrogen fuel cell technology.

The BC Building Corporation has installed a 180-tube Thermomax evacuated heat-pipe solar collector system at the Provincial Archives in Victoria. Used to heat water for photo processing, the system will save an estimated 12 tonnes per year of $CO_2$ emissions.

Zero emission vehicles—vehicles with no tailpipe emissions—have the potential to significantly improve local and global air quality. The B.C. government is seeking ways to encourage ZEVs through its purchasing policies, research and development funding, public education and vehicle standards regulations.

In particular, the government will evaluate the purchase of new buses powered by hydrogen fuel cells developed by Ballard Power Systems of Vancouver, for use in the BC Transit fleet. Because the hydrogen used in the Ballard fuel cell is currently produced from natural gas, there would be minimal greenhouse gas benefits in the near term. Over the long term, however, hydrogen may be produced from renewable sources, such as solar energy. The Ballard purchase would give a boost to made-in-B.C. technology, and could offer a large environmental pay-off in the future.

## Energy Conservation and Efficiency

Conservation and energy efficiency are integral to a no regrets strategy for GHG management, providing cost savings and other emissions benefits that are valuable over and beyond the need to address climate change. The residential and commercial sectors generate 18% of B.C.'s greenhouse gas emissions. Making buildings and equipment more energy efficient remains an important GHG reduction measure for these sectors.

### Public Action Tip One
### At Your Workplace

You can be a leader where you work, to encourage energy efficiency and help protect the environment:

- *Ask your employer to consider a carpooling or vanpooling program, as well as alternative work patterns, such as compressed work-weeks or telecommuting.*
- *Ask your employer to discourage unnecessary use of vehicles by providing facilities (e.g. bike lock-ups and showers) and financial incentives (e.g. per kilometre allowances and reduced parking rates) for walkers, cyclists, public transit users and participants in ridesharing programs.*
- *Switch off your computer, printer, fax machine and other office equipment at night or when not in use, and encourage fellow employees to do the same.*
- *If your workplace doesn't already have one, start a recycling program for paper, aluminum cans and glass bottles.*
- *Start an employee awareness program to promote energy efficiency and environmental consciousness, with awards for special efforts or innovative ideas.*

## What Communities are Doing

Victoria, Vancouver, Edmonton, Regina, Toronto, Ottawa and Montreal are members of the Canadian Federation of Municipalities "20% Club," which has publicly committed to reduce GHG emissions by 20% of 1988 levels by the year 2005.

The Greater Vancouver Regional District (GVRD) has shown leadership in transportation, air quality and urban growth planning. Its Transport 2021 Plan, Air Quality Management Plan and Livable Region Strategy all contain recommendations that translate into reduced energy use and greenhouse gas emissions.

The Capital Regional District has been extending its planning function to include transportation and other issues. Already completed are a Regional Transportation Study, Regional Parks System Plan and a green space strategy.

The City of Kamloops—the first B.C. municipality to use methanol fuel in its vehicles—has 10 methanol and 35 propane vehicles that save money and reduce emissions.

**9. Develop new financing and delivery mechanisms for energy efficiency.**

Since 1990, utility conservation programs have saved considerable amounts of energy for B.C. business, industry and private citizens. Power Smart alone is estimated to have saved more than 1 400 million kilowatt-hours of electricity—enough to run around 45 000 homes—and reduced GHG emissions by almost 800 kilotonnes per year. Recently, however, low electricity rates, the falling costs of new generation, and the prospect of increased competition have started to challenge the long-term viability of utility incentive programs.

The province supports utility efforts to find cost-effective ways for delivering energy efficiency services, including shared savings arrangements that recover more of the costs from customers served. It also advocates an expanded role for private energy service companies in B.C. An Energy Efficient Public Buildings Initiative (Action 1), together with recent changes in school funding that encourage energy savings, should provide some impetus for that private sector development. In addition, the government will work with utilities to develop new financing mechanisms for energy efficiency, such as cash-flow financing, that enable energy retrofits to be financed from energy bill savings.

**10. Upgrade provincial energy efficiency standards for new appliances and equipment.**

B.C. was one of the first provinces to enact legislation for equipment standards, with the passage of the *Energy Efficiency Act* in July 1990. Since then, regulations have been introduced and amended twice a year to include new products and standards. The current regulations set minimum energy efficiency requirements for 30 different products—including refrigerators and freezers; dishwashers; clothes washers and dryers; ranges; furnaces; electric motors; fluorescent lamp ballasts and roadway lighting. New standards for lighting equipment, air conditioners, heat pumps and water heaters are planned for 1996.

Energy efficiency regulations require that appliances and equipment meet national standards set by the Canadian Standards Association and the Canadian Gas Association. While B.C.'s standards are generally set to match those in place in other jurisdictions, the province has consistently pushed for tougher controls. Effective January 1995, B.C.'s electric motor standards became the most stringent in North America.

**11. Introduce B.C. Energy Codes for new houses and buildings in 1997.**

The current B.C. Building Code contains some basic insulation and window requirements for housing, but no energy requirements for high-rise apartment, commercial and institutional buildings outside the City of Vancouver. Public consultations began in May 1994 to develop the B.C. Energy Codes for Houses and Buildings, based on the model National Energy Code. The national requirements are being adapted to meet the need for a building code that reflects B.C.'s climate, local energy prices

Success Stories

### What Industry is Doing

Under Power Smart, Canadian Airlines has installed energy efficient lighting and improved the maintenance of its ventilation system at the Vancouver International Airport. The result is a 50% decline in energy consumption, with a payback of less than a year.

In 1994, Chemical Lime of Canada Inc. won a Power Smart Award of Excellence for reducing energy use by 30% at its Langley lime plant. A new limestone crusher system, computer controls and other energy efficiency measures saved the plant an estimated 7 000 tonnes in $CO_2$ emissions.

MacMillan Bloedel has installed adjustable speed fans at its lumber drying facility in Port Alberni, cutting fan energy use in half and saving over $4 000 annually.

and regional construction costs. Expected energy savings from the two codes are 12% for housing and 6% for other buildings on average.

To be successful, the B.C. Energy Codes must not unduely burden municipal governments and building officials who will be responsible for enforcement. It is also critical that the province's utilities and building industry (architects, builders, suppliers, inspectors, etc.) actively support and implement the codes. An implementation plan is being prepared to ensure that these key players are well-trained and have the right tools for effective administration and enforcement.

**12. Launch initiatives to make B.C. communities more energy efficient.**

There is a strong link between community energy use and elements of urban infrastructure, such as population density, land use patterns, zoning and building standards. Yet, community energy planning is often overlooked in local land use planning. The B.C. Energy Council made better community design and energy planning a cornerstone of its provincial Energy Strategy.

The Ministry of Energy, Mines and Petroleum Resources is launching an Energy Efficient Communities Program that will develop tools for community energy planning and programs, and provide information to local governments on energy efficiency and alternative energy sources. This program will also continue activities initiated through the BC 21 Power Smart Community-Based Energy Efficiency Projects (Action 18).

**13. Encourage the use of district energy systems.**

District energy refers to a centralized system that supplies heating or cooling energy through underground pipes to a number of surrounding buildings. Thermal energy can be provided by a centralized system not only more cost-effectively, but also at higher efficiency and with fewer emissions than can be achieved by individual energy systems. Modern district energy systems often involve the "cogeneration" of heat

*The B.C. Advanced House in Surrey, designed by the architect Richard Kadulski, demonstrates environmentally responsive and energy efficient building technologies.*

### Utility Efficiency Programs and Market Restructuring

*During its recent public review of alternative electricity market structures, the B.C. Utilities Commission heard concerns that utility energy efficiency or "demand-side management" (DSM) programs will suffer under an increasingly competitive market environment. The Commission, however, maintains that utility programs will continue to have a role under any market structure, as long as costs can be recovered from the broad base of customers benefiting from them (BCUC 1995). There is evidence that B.C.'s electric utilities can still sponsor substantial, cost-effective energy efficiency improvements. For example, B.C. Hydro's 1994 Conservation Potential Review estimated that another 18-20% of total electricity demand could be economically saved by the year 2000. While natural gas markets have faced competitive pressures since the 1980s, B.C.'s gas utilities are actively embarking on DSM programs as part of their integrated resource planning.*

### What Industry is Doing

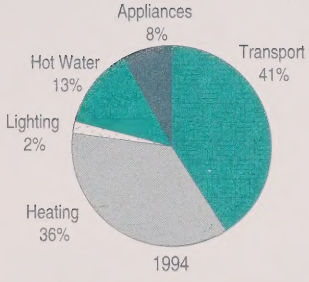
Since its introduction in 1989, B.C. Hydro's Power Smart concept has spread to over 30 utilities and energy agencies across Canada and in other countries. West Kootenay Power has also run successful energy efficiency programs, including its Home Guard energy retrofits.

The Sheraton Landmark Hotel in downtown Vancouver has an energy management program that includes reduced lighting in unused areas, timing and dimmer switches, and hot water system improvements. Savings exceeded $40 000 in 1993.

Salt Licks Projects of Vancouver has developed a ground source heat pump system that provides combustion-free heating to a residential and commercial complex in the Kitsilano area. Excess energy available from cooling commercial space on the ground floor is used to heat upstairs offices and residences.

energy and electricity. In Europe, many communities and large building complexes use district energy to meet their space conditioning (heating and cooling) needs.

Vancouver has one of the largest district energy systems in Canada. A study of district energy applications and opportunities in the province has been initiated by the Ministries of Energy, Mines and Petroleum Resources and Environment, Lands and Parks; Natural Resources Canada; B.C. Hydro and BC Gas. Under the Energy Efficient Communities Program, district energy will be considered in community energy planning.




*The average B.C. household consumes 190 gigajoules of energy a year.*

Source: B.C. Ministry of Energy, Mines and Petroleum Resources

### Household Energy Use and GHGs

*How household energy consumption translates into greenhouse gas emissions depends on the fuel source for different end uses. Assuming a conventional gasoline vehicle and natural gas for home heating, annual $CO_2$ emissions per household would be in the order of: 5.4 tonnes for transportation; 3.5 tonnes for space heating; and 1.2 tonnes for water heating. The emissions from lighting and appliance energy use would depend on the generation source for electricity, but could range from zero tonnes per year for hydroelectricity or energy from wood residue, to 1 tonnes per year for gas-fired generation.*

**14. Develop a system to rate the energy performance of homes.**

Home Energy Rating Systems (HERS) provide information on the energy efficiency of a home, often rating it against similar buildings. HERS programs typically provide a detailed energy audit, a computerized rating which compares home performance, and a priorized list of retrofit measures. HERS programs have been successfully introduced elsewhere in North America and around the world.

The BC 21 Power Smart program will test an energy audit and rating process in about 2 500 homes over the next year. Provincial utilities and the federal government are also participating in the B.C. HERS pilot, which will assist in the creation of national guidelines and rating tools. The objective is to develop a program inexpensive enough to be marketed directly to homeowners, or to be used by renovation contractors for marketing energy retrofits to consumers.

**15. Support the creation of a Centre for Building Excellence.**

One of the B.C. Energy Council's recommendations was the creation of a centre for excellence in energy efficient building technology that would sponsor research, education and communications in the building sector. For example, the centre could develop and deliver training in energy codes and rating systems, and provide guidelines and expertise in energy efficient design and construction. Public

Success Stories

### What Communities are Doing

Three B.C. communities have signed on as BC 21 Power Smart Community-Based Energy Efficiency Projects (CBEEPS). Osoyoos has shown especially strong local support, emphasizing water conservation in its project. Golden was the first community to receive detailed energy audit training for local contractors. Pacific Northern Gas has teamed up with Smithers' CBEEP to add the installation of efficient furnace thermostats.

The Union of B.C. Municipalities has signed a Memorandum of Understanding with the Ministry of Energy, Mines and Petroleum Resources to jointly plan, develop and implement energy conservation, efficiency and alternative energy programs at the local level.

Between January and September 1995, the City of Kamloops saved $30 000 in building electricity costs, mostly from the installation of direct digital controls.

consultations are underway to evaluate organizational, funding and other options for a centre.

**16. Expand the government's energy education and consumer information programs.**

A major barrier to increased energy efficiency is a lack of awareness of opportunities for, and benefits of, energy efficiency. To address this barrier, the government will work with utilities and other partners to develop new consumer information and education resources.

The federal government's EnerGuide program requires energy efficiency ratings to be displayed on many household appliances, giving consumers the information they need to make informed, energy conscious decisions. However, information about the efficiencies of many other popular appliances and products—such as gas fireplaces, windows and showerheads—is not readily available, even though different models may vary widely in their energy use. The government will develop and distribute consumer information materials on selected products, and will investigate whether or not B.C. should require EnerGuide-type labels on products not included in the federal program.

### Public Action Tip Two
### In Your Home

Everyday household behaviour can reduce energy consumption and GHG emissions, for example:

*• Install a programmable thermostat, or turn down your thermostat when you're asleep or out. Switch to compact fluorescent light bulbs and buy the most energy efficient appliances you can afford.*

*• When choosing a space heating system for your home, consider a high efficiency furnace or a heat pump. Also, a heat recovery ventilator can transfer heat from the air leaving your house to incoming fresh air from outside.*

*• Insulate your water heater, install water saving shower heads and faucet aerators, and run your dishwasher and clothes washer only with full loads.*

*• Insulate your home effectively. Caulk or weather-strip cracks and holes, as well as windows and doors. Install windows that efficiently prevent heat loss—plastic insulating sheets are a good, interim solution. Better yet, an energy efficient R-2000 house can reduce annual energy consumption by over half that of a conventional home.*

*• Make sure your fireplace vent is closed when not in use.*

### What Communities are Doing

Created by the B.C. Energy Council, the Energy Aware Committee will promote community energy planning by developing planning tools and funding community studies. In 1996, it will sponsor an energy planning case study for one B.C. community facing urban sprawl or other energy-related challenges.

The GVRD's Livable Region Strategy calls for the creation of more complete and contained communities, with designated Green Zones. One of its most innovative features is the marriage of land use planning and transportation planning.

**17. Evaluate options for including social costing requirements in the determination of energy efficiency standards and codes.**

B.C.'s energy efficiency standards are set so that the financial benefits of higher efficiency (energy cost savings over time) more than compensate for any extra costs of the equipment. Environmental benefits are typically not factored into the analysis. However, the U.S. Department of Energy takes into account the quantity of air emissions reduced when setting federal energy efficiency standards for new appliances and equipment. Also, Manitoba has included a 10% social costing multiplier in the evaluation of efficiency levels for building energy codes. B.C. will investigate similar requirements and consider implementing them in future revisions to the *Energy Efficiency Act* regulations and the B.C. Energy Codes.

### More Definitions

**Social costing** *requires that the environmental and other costs and benefits external to an organization be included in its planning and investment decisions. In particular, energy utilities use this principle to help compare new sources of power or natural gas based on lowest social cost—defined as private financial plus external costs.*

**Life-cycle analysis** *takes into account all the embodied energy and emissions that go into producing goods and services over their useful lives and decommissioning. For example, life-cycle building energy use considers the energy needed to provide materials for, construct, operate and disassemble a building during its lifetime.*

**18. Evaluate options for extending the BC 21 Power Smart program for energy conservation in existing homes.**

A unique partnership between the government and B.C.'s electric and gas utilities is targeting the installation of energy and water saving devices in 75 000 homes around the province. The BC 21 Power Smart Program encourages homeowners to upgrade energy efficiency through preferred interest rate loans available from provincial credit unions. Community-Based Energy Efficiency Projects (CBEEPS) in four towns cover another 6 500 homes. In addition, 12 special research and development projects are being sponsored to test innovative technologies and approaches to energy and water conservation.

The current $20-million program is jointly funded—three-quarters by the province and one-quarter by utilities—with B.C. Hydro as the lead delivery agency. Expected energy savings are 218 000 gigajoules per year, enough electricity and natural gas to run 1 900 homes. Provincial funding for the program is scheduled to end in the spring of 1996. The government will explore options to extend the program, in order to ensure that the local infrastructure is in place for the private sector to take over energy retrofits and their funding in the future. As an unprecedented collaboration among B.C.'s energy utilities, it may be possible to continue the program through utility funding.

Success Stories

### What Government is Doing

The BC Building Corporation (BCBC) operates as an energy service company, capturing 60% of business from provincial and local government offices. BCBC has won five international awards for excellence in energy management and two B.C. Hydro Power Smart awards for achievement in energy efficient building design.

With government and utility funding, the Sage Foundation is delivering Destination Conservation, an innovative environmental education and energy retrofit program in B.C. schools. The program teaches behavioural changes through "Conservation Action Plans" prepared by a principal, teacher, janitor, parent and student.

The Dawson Creek School Board (District #59) has B.C.'s longest running Destination Conservation project, providing over $24 000 in energy cost savings between January and August 1995. The project has reduced natural gas use by 10%, returned a share of the cost savings to the schools, and increased student awareness of the need for energy efficiency and environmental protection.

## Transportation

Transportation is the largest single source of B.C. greenhouse gases, producing over one-third of total emissions. Cars and trucks account for most of these emissions. The province, municipalities and industry have launched a number of efforts to reduce vehicle energy use and air emissions, particularly in the Lower Mainland. New technologies in vehicles and fuels can help control the growth in emissions. However, reducing the demand for vehicle trips—through mass transit, carpooling and other measures—is essential to achieving B.C.'s immediate stabilization and long-term GHG reduction goals.

**19. Put B.C.'s Transportation Strategy into action.**

"Going Places," the new provincial transportation strategy, marks a new way of thinking about transportation infrastructure: how best to move people and goods, instead of vehicles. The strategy takes a comprehensive view across all regions and modes of transport, and emphasizes the need to integrate transportation and land use planning. Although they are aimed at providing infrastructure cost savings, several of the plan's components will help reduce GHG emissions, notably:

- construction of a high occupancy vehicle (HOV) network in the Lower Mainland, with 24-hour HOV lanes for vehicles with three or more passengers;

### Public Action Tip Three
### In Your Home

Here are some more household suggestions:

- *Recycle used paper, plastic, aluminum and glass, and buy products with recycled content. Goods made from recycled materials consume less energy in their manufacture.*
- *Use small appliances, such as electric kettles, coffee makers and microwaves, instead of less efficient ovens or stovetops.*
- *Turn off lights, computers, TV and stereo, when no one is using them.*
- *Contact B.C. Hydro to arrange for your old inefficient refrigerator to be picked up free of charge and taken out of circulation.*
- *Plant and maintain trees in your yard, and don't cut your grass as often. Longer grass needs less water, and gasoline lawnmowers are extremely polluting and inefficient. Use an electric or push lawnmower instead.*

Success Stories

### What Government and Industry are Doing

BC Transit's GHG reducing measures include its electric trolley system in the GVRD, the planned addition of 14 minibuses for outlying communities, and a pilot program to test bike-rack-equipped buses on several transit routes. For the new West Coast Express commuter rail service to downtown Vancouver, it is buying five new fuel efficient locomotives that emit less pollution and can be converted to natural gas.

BC Transit also runs a successful Employee Transportation Administrator program which teaches other companies about trip reduction strategies, such as ridesharing and telecommuting. The program encourages the formation of TDM associations, whereby employers located at nearby work sites cooperate in trip reduction.

In June 1995, William M. Mercer Ltd. surveyed 113 private sector employers in B.C., and found that 30% had embraced some form of telecommuting, while another 26% were considering doing so.

- the "People Moving Project" of HOV lanes for the Barnett Highway-Hastings Street corridor to downtown Vancouver;
- a 10-year BC Transit plan that includes commuter rail, a rapid bus service and more SkyTrain cars; and
- a transportation demand management system to discourage the use of single occupant vehicles.

If the transportation plan is to have a sizable impact on emissions over the long term, the province must consider increased mass transit, bridge and highway tolls, and additional strong actions to cut vehicle use. The BC Transportation Financing Authority is in the process of reviewing these options.

### Trends in Vehicle Purchases

*Canadian gasoline prices are over 30% higher than U.S. prices, and vehicle affordability—as measured by an income to vehicle price ratio—is almost 30% lower. As a result, Canadians have traditionally bought smaller cars, making the average Canadian car almost 0.9 km/litre more fuel efficient. However, a decline in real gasoline prices during the 1980s has contributed to a demand shift towards larger, more fuel-consuming vehicles. Light trucks and vans have increased their market share in Canada from 13% in 1978 to 31% in 1995.*

**20. Implement a coordinated provincial transportation demand management program.**

B.C.'s experience with TDM has been fairly limited, with a patchwork of ad hoc efforts by provincial agencies, regional and local governments, private sector employers and other organizations. The Transportation Financing Authority will coordinate a new initiative to develop TDM strategies for the province's major urban areas. Strategies will be prepared in cooperation with municipalities and regional districts, starting with the Greater Vancouver Regional District. Both the GVRD's Livable Region Strategy and Transport 2021's Long-and Medium-Range Plans support the early introduction of TDM measures. In 1993, Transport 2021 estimated that a comprehensive trip reduction program could cut growth in peak commuting requirements by as much as one-half for the Lower Mainland.

**21. Provide funding for infrastructure under the Cycling Network Program.**

In July 1995, the province announced a program to create new cycling infrastructure for commuter cyclists in B.C. The program is designed to relieve urban congestion and promote a multi-modal transportation system. New infrastructure will be cost-shared on a 50/50 basis with local governments. Some $2 million of provincial funding has been allocated for the 1995/96 fiscal year.

Success Stories

### What Industry and Non-Profit Groups are Doing

BC Tel has more than 1 000 employees in carpooling or vanpooling programs, and provides parking concessions for personal carpools.

In 1994, Canadian Airlines International won the Go Green Air Quality Award for operating the province's longest running vanpool program, as well as a day care centre for parents who rideshare.

The Jack Bell Foundation operates most of B.C.'s approximately 95 vanpools, which have reduced automobile use by an estimated seven million vehicle kilometres a year, for an annual $CO_2$ reduction of over 1 600 tonnes.

**22. Expand transportation energy efficiency initiatives.**

GHG emissions from transportation can be reduced by maintaining vehicles properly and driving efficiently. Incorrect tire pressure alone can increase fuel consumption by as much as 10%, besides reducing handling and safety. The Ministry of Energy, Mines and Petroleum Resources promotes transportation energy efficiency through Fuel Smart, a series of education, awareness and driver training programs.

The B.C. government will work with the federal government, local governments and fleet operators to expand Fuel Smart to include a fleet management program. Through seminars, workshops and publications, the program will provide information to fleet managers on fuel efficient vehicle selection, maintenance and operation, as well as alternative fuel and low emission vehicles. The program will also identify opportunities for coordinated purchasing of new vehicles.

**23. Carry out the provincial Clean Vehicles and Fuels Program.**

B.C.'s Clean Vehicles and Fuels Program is an umbrella initiative designed to reduce air emissions from vehicles. The program involves a number of actions, including improved vehicle emissions testing and maintenance, emission standards for new vehicles, cleaner gasoline and diesel fuel, and vapour recovery at Lower Fraser

*Bike lockers at BC Transit's Scott Road Sky Train Station in Surrey promote commuter cycling.*

### Public Action Tip Four On Your Way

You can cut down on greenhouse gas emissions when you travel for work or pleasure:

- *Break the automobile addiction! Walk, ride your bike, use public transit, or join a carpool. Even if each of us leaves the car at home just once a week, the reduction in emissions will be substantial.*
- *Consider a condensed work-week or telecommuting as a viable alternative to your usual work patterns.*
- *Travel with others heading your way and combine errands to use less gas. Turn off your engine if you're waiting somewhere for more than a minute or two. Slow down when you drive and don't tailgate, to avoid braking and accelerating—it's safer and saves on gas.*
- *Keep your vehicle's engine in top condition with a regular tune-up and annual emissions check. Maintain proper tire pressure and use radial tires to cut down on drag and gas consumption.*
- *When flying, reduce the weight of your luggage. Every pound less on your average flight saves $15 a year in aircraft fuel and over 110 kilograms of GHG emissions.*

### What Communities are Doing

Through the Cycling Network Program, local governments are recovering half of the costs to install new commuter cycling facilities. For the 1995/96 fiscal year, 39 different municipalities have made 81 funding requests, amounting to $5 million in infrastructure investment.

New legislation allows municipalities and regional transit authorities to levy tax on property used for nonresidential parking. This parking levy could be used to develop public transit.

Valley gas stations. Regulations and policies to implement the program will be introduced in 1995 and 1996.

The program's primary goal is to reduce local emissions of fine particulates and ground-level ozone, the major components of smog. Among the options being developed or considered that could reduce GHG emissions are:

- tighter test-limits for light duty vehicles under the AirCare vehicle emissions inspection and maintenance program, and expansion of the program to heavy duty trucks and buses;
- a voluntary scrap program for old vehicles, to be test-piloted in the Lower Fraser Valley in conjunction with AirCare;
- the introduction of advanced technology vehicles (e.g. zero emission vehicles);
- the adoption of low emission vehicle (LEV) standards; and
- the promotion and purchase of alternative fuel vehicles (e.g. natural gas).

**24. Support alternative transportation fuels that reduce greenhouse gas emissions.**

B.C. plans to support the use of propane, natural gas and high-blend alcohol fuels (M85 and E85) through a continued exemption from motor fuel taxes for the next couple of years. The exemption is currently worth 11 to 15 cents per litre of gasoline equivalent (depending on regional transit levies), or more than $25 million annually. Although financial support cannot be maintained at this level, the temporary tax relief can help industry through the transition period until new alternative fuel vehicles are more widely available. The tax exemption is due to be phased out starting in 1997.

To ensure the necessary infrastructure for these kinds of fuels, the province—along with the federal government, natural gas utilities and the alternative fuels industry—is reviewing options to support the expansion of alternative refueling facilities. B.C. also led the development of Canada's first-ever alternative fuel vehicle conversion standard, and is working with industry to improve the emissions performance of existing conversions.

### Zero and Low Emission Vehicles

*To control tailpipe emissions, B.C. is considering emission standards that would require the transition to low and zero emission vehicles. LEVs, such as natural gas and propane vehicles, can also reduce $CO_2$ emissions, although the actual impact will depend on vehicle size and other factors. ZEVs powered by batteries or hydrogen fuel cells can produce more dramatic $CO_2$ reductions, depending on the source of electricity or hydrogen. Some of the current methods used to produce hydrogen result in GHG emissions. Nevertheless, the local emission advantages, especially over internal combustion engines, are considerable and hydrogen-based energy sources hold much promise in the long run.*

Success Stories

### What Government is Doing

Ministry of Transportation and Highways initiatives to encourage trip reduction include a Sky Train expansion with BC Transit, involving three new stations and 20 more cars. Also, 60 bicycle storage lockers are being added at two Sky Train stations and two bus stations.

The AirCare program—developed jointly by the province, Environment Canada and the GVRD—tests the exhaust systems of one million light duty vehicles per year. Since 1992, it has lowered GHG emissions by an estimated 113 kilotonnes a year.

**25. Together with the federal government, sponsor research on hydrogen, alcohol and other renewable fuel technologies.**

Although they are not at present economically viable, alcohol fuels from wood residue offer considerable long-term potential in B.C. Significant advances in these and other biofuels, as well as fuel cell technologies, are being made at research organizations, including B.C. universities. The province will continue to sponsor research on promising fuels and technologies, in cooperation with NRCan and other agencies.

**26. Evaluate options to require a minimum 10% renewable energy content in fossil fuels.**

Given its contribution to emissions, and the principle of accountability that guides this action plan, the transportation sector should assume its fair share of greenhouse gas reduction initiatives. While renewable fuels can be promoted through tax exemptions to reduce their price, a more direct route is to enact a regulation requiring that all gasoline and diesel sold in the province include a minimum renewable energy content. Such a regulation could mean higher costs for oil producers, refiners and distributors, which might be passed on in higher fuel prices to consumers. The Ministry of Environment, Lands and Parks will review this proposal in consultation with key stakeholders.

## B.C.'s Alternative Fuel Vehicles

| Fuel | Current Inventory (and Market Share) | Relative GHG Emissions[1] (Gasoline = 1.0) |
|---|---|---|
| **Propane** | 50 000 (2.0%) | 0.8 |
| **Natural Gas** | 7 000 (0.3%) | 0.8 |
| **Methanol** | 150 (0.0%) | 1.0[2] |
| **Ethanol** | N/A[3] | 0.4-1.2[4] |
| **Ethanol (5% Blend)** | N/A[3] | 0.9-1.0[4] |

[1] Potential values. Actual emissions will vary depending on test conditions and on vehicle type, size, age and configuration.

[2] Assumes natural gas feedstock.

[3] High-blend ethanol currently not available in B.C. Low blend used in gasoline vehicles.

[4] Depends on feedstock (low number for wood residue and high number for wheat/grain, based on current production processes).

Source: Ministry of Energy, Mines and Petroleum Resources (1994)

### What Industry is Doing

Ballard Power Systems of North Vancouver is developing a vehicle propulsion system using a hydrogen fuel cell, where the only tailpipe emission will be water. In 1996, the technology will be tested in three Chicago transit buses, with similar trials planned for B.C. and California.

Ensyn Technologies Inc.'s Rapid Thermal Processing project is testing the gasification of wood residue into bio-oil, which could be used to displace fuel oil in industrial applications.

The renewable energy content could be provided by ethanol, biodiesel fuel and other sources. Blends of up to 10% ethanol and 40% biodiesel can be used in existing gasoline and diesel fuel vehicles, respectively, without violating manufacturers' warranties. In the case of ethanol, for example, the purchase of wheat-derived ethanol from the prairies would mean an immediate 10% reduction in $CO_2$ emissions from B.C. vehicles. Biodiesel based on "tall oil" (a byproduct from pulp and paper mills), soy beans or another organic source could be used to reduce emissions from fleets, such as BC Transit buses or B.C. Ferry Corporation vessels. In any case, a renewable energy requirement in vehicle fuels could provide the largest net impact of any measure in this action plan—in the order of one megatonne of GHG reduction in the year 2000.

**27. Evaluate options for switching from diesel fuel to natural gas and renewable fuels in B.C. ferries.**

The B.C. Ferry Corporation consumes 135 million litres of diesel fuel annually to operate its vessels. B.C. Ferries and BC Gas have completed a study that considers both technical and economic issues for operation of the 100-car Century class vessels now under design. Preliminary indications are that these ferries could be economically built to run on natural gas. For the existing ferry fleet, natural gas could also be introduced when engines are rebuilt or ferries replaced.

Renewable fuels (biodiesel) could also be substituted for a portion of the diesel fuel used, with little technical difficulty. The Transportation Financing Authority will work with the B.C. Ferriy Corporation to address the economic and institutional barriers to reducing diesel fuel consumption.

## Energy Supply

The energy supply sector is the fastest growing source of GHG emissions. Although today electric power accounts for a small share of total emissions, this share is expected to more than double by the year 2000 with a move to more gas-fired generation. Emissions from the production, processing and distribution of natural gas are also rising substantially, due partly to rapidly expanding exports since 1990. As a result, while it will remain one of the smaller contributors to B.C.'s greenhouse gas emissions, energy supply can play a significant part in controlling the growth in these emissions.

**28. Implement and extend full-scale integrated resource planning for B.C.'s energy utilities.**

In February 1993, the B.C. Utilities Commission issued integrated resource planning (IRP) guidelines to be applied to provincial electric and gas utilities. IRP requires that all new energy resources (including supply and efficiency options) be evaluated consistently in a public process that considers their environmental impacts and risks. B.C. is one of the few provinces to make the evaluation of environmental and social impacts mandatory, using a multiple accounts (social costing) framework. All utilities have submitted their initial plans.

Success Stories

### What Government and Industry are Doing

BC Rail is acquiring new, fuel efficient locomotives, re-engining older locomotives and reducing its locomotive fleet, in order to cut overall energy use.

For years, the Ministry of Transportation and Highways has operated Albion ferries across the Fraser River. These ferries run on natural gas, extending their engine life by four times.

By converting almost all of its large parcel vans to propane, United Parcel Service has saved almost $1 million a year nationwide, with a payback period of 1.5 to 2 years.

With government support, the B.C. Trucking Association has operated Pro-Trucker, a series of seminars to teach energy efficient driving techniques to operators of heavy duty trucks.

The province and the B.C. Utilities Commission are reviewing options to extend IRP principles, including their application to off-grid electric and gas system extensions. Policies will be developed from the results of a public hearing on system extensions conducted in late October 1995. The government will also adopt formal social costing guidelines for use in integrated resource plans (Action 39).

**29. Work with the B.C. Utilities Commission and regulated utilities to ensure that GHG management is an integral part of utility planning and operations.**

Regulated energy utilities are major sources of greenhouse gas emissions in B.C. The government will work with the Commission and provincial utilities to:

- identify opportunities for reducing GHG emissions, through energy efficiency programs, resource acquisition, rate design and other utility operations;
- develop effective GHG management plans for B.C. utilities; and
- ensure that the consideration of GHGs and other environmental issues are fully integrated into utility planning and operations.

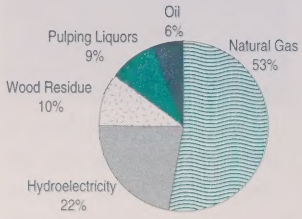
The province will also consider issuing a Special Direction to the Utilities Commission on greenhouse gas management.

**30. Provide better access to the grid for electricity generated from private sources, such as renewable energy and cogeneration.**

One of the barriers that is consistently cited by renewable energy and other private power producers is the lack of fair "wholesale wheeling" rates for gaining access to utility transmission systems. So far, these rates for wholesale transmission service have been negotiatied by B.C. Hydro on a customer-by-customer basis. B.C. Hydro plans to file a new application for standardized rates with the Utilities Commission by the end of 1995. In its recent Electricity Market Structure Review, the Commission recommended that all utilities owning transmission facilities file similar rate applications. Under market restructuring, the costs of electricity generation and transmission could end up being regionally differentiated. If this occurs, it should improve the economics of renewable energy and cogeneration in more remote and other higher cost areas.

### Industry Cogeneration

*The cogeneration of heat and electric power offers greater efficiencies in energy production. At present about 5% of B.C.'s total electricity generating capacity consists of industrial cogeneration. Most of this capacity is at pulp and paper mills, using natural gas and wood residue (hog fuel). In an evolving electricity market, industrial cogenerators may find new opportunities for sales of surplus heat and power to electric utilities, export markets and branch plants.*




*40% of B.C.'s energy supply (hydroelectricity, wood residue and pulping liquors) produces no net GHG emissions.*

### What Industry is Doing

Since 1988, Mohawk Oil Co. Ltd. has sold a premium gasoline blend of 5% ethanol in its 100-odd service stations across B.C. The company is now considering Lower Mainland sites for selling higher blends, to accommodate Ford's new E85 vehicles due out in early 1996.

The Canadian Petroleum Products Institute has made a commitment with the Canadian Industry Program for Energy Conservation (CIPEC) to reduce energy intensity by 1% per year between 1995 and 2000.

**31. Support the development of renewable energy sources through information and training.**

Renewable energy—primarily hydroelectricity and energy from wood residue—supplies nearly 40% of B.C.'s energy needs, compared to 15% for Canada as a whole. The Renewable Energy Program of the Ministry of Energy, Mines and Petroleum Resources focuses on small renewables (solar, wind and micro-hydro power), which are economical in many off-grid or remote applications. Support is provided through training, the development of standards and codes, public education and demonstration projects.

*The natural gas industry is reducing gas leakage from the over 17 000 km of pipeline in the province.*

**32. Initiate a review of provincial policies and regulations that affect petroleum and natural gas production.**

Much of the oil and gas sector's contribution to GHGs comes from the production and processing of oil and natural gas. The Ministry of Energy, Mines and Petroleum Resources conducts regular reviews of its policies and regulations for the petroleum and gas sector. As part of the next review, the province will consider options for making this system more responsive to greenhouse gas emissions and their management.

## Forestry and GHG Sinks

The sustainable management of B.C.'s forests has a role to play in the control of greenhouse gases. Depending on forest management strategies, our forests could be either net sinks or net sources of carbon. Some jurisdictions, such as Oregon, New Zealand, Sweden and Norway, have proposed forest growth as a way to offset fossil fuel emissions. Besides the impact of forests, the forest products sector itself contributes to GHG emissions, from the burning of fossil fuels in pulp and paper, and sawmill, operations.

**33. Model carbon cycling to assess the carbon balance in B.C.'s forests.**

Provincial forestry experts are skeptical that our forests can provide a significant long-term offset to fossil fuel emissions. Although available evidence suggests that B.C.'s forests are currently a small net carbon sink, over the long term sustainable management of forest lands will work towards carbon balance. Afforestation of nonforested or marginal agricultural land has been suggested as one prospect for a long-term offset. However, the slow growth rates of our tree species, combined with limited availability of land, suggest that this option will not contribute significantly to GHG management in the next 10 or 20 years.

In any case, the relationship between forests, forest management and the carbon balance is a highly complicated one. (For more explanation, please refer to the Ministry of Forests' *Primer on Forests and $CO_2$*, an appendix to this action plan.) Ministry of Forests researchers, in cooperation with the Canadian Forestry Service, are adapting the Canadian Forest Sector Carbon Model to better represent B.C.'s ecosystems. This model considers all of the forest estate in determining the impact of natural and human-caused disturbances, as well as wood processing and use, on the release and uptake of $CO_2$. The model will be used to assess how rates of disturbance and forest management affect the carbon

### What Industry is Doing

Westcoast Energy's Pipeline Division is operating a program to reduce and eliminate by 1998 the flaring of gas liquids. Other methane reducing measures include a new pumpdown compressor to control gas venting during pipeline repairs and measures that cut in half the start-up time of gas turbines at older compressor stations.

Since 1990, BC Gas has made a number of changes to its pipeline operations, including control equipment upgrades to cut methane emissions during construction and maintenance, and reduced use of pipeline heaters.

Centra Gas has one of the industry's most comprehensive emissions monitoring procedures. Employees record actual methane losses in the field, rather than applying industry average loss factors to the pipeline length.

balance. Results from this modeling effort should be available by the end of the year.

**34. Maintain carbon stores through the forest sustainability initiatives.**

Sustainable forestry practices are recognized as one way to meet international agreements on protecting and enhancing carbon sinks. To minimize the net loss of $CO_2$ to the atmosphere, B.C. is pursuing rapid reforestation and growth of a healthy, mature forest after disturbance; processing harvested wood into products with as long a life as possible before decay; and practicing the "reduce, reuse and recycle" maxim. The province has a number of existing policies and recent initiatives to ensure forest sustainability:

- Timber supply reviews are done regularly to provide information for allowable cut determination, and to ensure that harvest rates are in tune with future forest growth.
- The new Forest Practices Code sets some of the world's most stringent standards for appropriate harvesting and reforestation practices.
- The multi-million dollar Forest Renewal Plan will include funding for value-added industries, environmental restoration and forest research.
- CORE (the Commission on Resources and Environment) and other land use planning initiatives will secure a viable land base for commercial forestry, and double the area of parks and wilderness in the province.

### Forests and Carbon Cycling

*A forest's rate of carbon storage varies with climate, location and age of the trees. Total $CO_2$ stored in a young forest is small, but increases rapidly. As the forest matures, $CO_2$ storage continues to increase, but at a slower rate. In an old-growth forest, the amount of $CO_2$ released through respiration and decay approximately equals that taken up through photosynthesis. Coastal forests tend to store more $CO_2$ than interior forests, mainly because disturbances (i.e. fire) affect coastal forests less frequently.*

*Sustainable forestry practices help achieve long-term balance in the carbon cycle.*

**35. Implement the Beehive Burner Phase-Out Policy, encouraging other value-added uses for wood residue.**

The wood products sector is a major component of the B.C. economy. Historically, wood residue from this sector has been burned inefficiently in beehive or silo burners, damaging local air quality. In 1993, the Ministry of Environment, Land and Parks developed a policy to phase out 90 wood residue burners by January 1, 1996, and the rest by 2004. Nearly two-thirds of the burners have already shut down, or have specific plans to do so pending approval by the Ministry.

With this phase-out, large quantities of wood residue—about five million tonnes a year—will no longer be incinerated.

### What Industry is Doing

Aside from Power Smart, B.C. Hydro has saved an annual 2 100 kilotonnes in GHG emissions since 1990, through Resource Smart improvements to existing generating stations and purchases from small hydro and wood residue sources.

For its recent Integrated Electricity Plan, B.C. Hydro evaluated a resource scenario to control $CO_2$ emissions. Since 1992, the utility's Resource Acquisition Policy has valued these emissions at $15 per tonne, based on estimated tree planting costs.

The new B.C. Renewable Energy Association has been working with government on an annual solar technology conference and on Canada's first training and certification program for photovoltaic system installers.

B.C. Hydro—and, more recently, Pacific Geopower—have been exploring for geothermal energy in the Pemberton area of southwestern B.C. Geothermal power is a clean, renewable form of energy that uses the earth's naturally occurring heat.

Industry and government are working together to find alternative uses for this valuable resource. One option is to generate biomass energy, in the form of steam and/or electricity, which can provide $CO_2$ reduction benefits by displacing natural gas or fuel oil. (International agreements do not regard the burning of biomass as contributing to GHG emissions, provided that the biomass is derived from sustainable resource practices.) Another option is to direct whitewood residue to the manufacture of value-added products, such as medium-density fibreboard in B.C.'s Interior. This activity will tend to store or "sequester" the carbon in relatively long-lived products, such as kitchen cabinets. Further down the road, it may be economically feasible to produce alcohol fuels from wood residue.

### Energy from Wood Residue

*The phase-out of beehive burners provides the opportunity to redirect wood residue into electricity generation and other uses. As the beehive burners are phased out, the provincial government expects that markets will reallocate wood residue into its highest value uses. While this may encourage the use of some wood residue for electricity generation, the government also believes that the acquisition of all new electricity supplies in B.C. should be based on need and evaluated within a consistent social costing and integrated resource planning framework.*

## Agriculture and GHG Sinks

Agriculture occurs on less than 3% of B.C.'s land base, and is a small contributor to provincial emissions of $CO_2$, methane and nitrous oxide. Although growing crops represent a carbon sink and can help to increase carbon in the soil, without proper management the soil's organic matter will be slowly depleted, thereby releasing $CO_2$. The agricultural sector is already taking measures that make good agronomic sense, while helping to reduce GHG emissions and, in some cases, increase carbon absorption.

**36. Examine and encourage agricultural practices that provide both cost savings and greenhouse gas benefits, for consideration in future development of the action plan.**

There are already provisions in the *Farm Practices Protection Act* and Codes of Practice that may help reduce greenhouse gas emissions. Agricultural practices implemented to date include: the use of low-tillage systems, especially in the North; intensified forage production through the Grazing Enhancement Fund; and manure management and optimal fertilizer application, particularly in the Lower Fraser Valley. On the other hand, agroforestry—which combines agricultural and forest operations—is all but nonexistent in B.C., in part due to land tenuring constraints. The Ministry of Agriculture, Fisheries and Food will continue to study and promote sustainable agricultural practices, and will work with the Ministry

### What Industry is Doing

Amoco Canada has reduced or eliminated natural gas flaring at a number of operating gas fields in Alberta and B.C., for a total estimated GHG reduction of over 37 kilotonnes annually.

Home Oil is collecting previously flared solution gas from its Cecil battery north of Fort St. John and has installed gas boots to prevent flaring, for an estimated GHG reduction of more than 14 kilotonnes per year.

Atcor Ltd. has installed a compressor to conserve solution gas at its Doig oil well near Fort St. John, and added gas boots and an incinerator to burn vent gas off oil and condensate tanks.

Poco Petroleums Ltd. is re-injecting sour gas for pressure maintenance and $CO_2$ conservation at the Stoddart gas injection station.

of Forests to identify and address restrictions on agroforestry in the province.

## Solid Waste Management

Landfills are the main human-caused source of methane in B.C., accounting for 20% of total GHG emissions. By far the vast majority of landfill emissions come from the disposal of municipal solid waste, with some contribution from the forest sector. Emissions can be reduced by cutting the amount of waste that goes to landfills and recovering landfill gas. Landfill gas emissions are expected to level off over the next decade, in response to provincial and municipal action.

**37. Achieve B.C.'s municipal solid waste reduction goals.**

The province has a goal to reduce the amount of municipal solid waste going to landfills or incinerators by 50% per capita by the year 2000. Initiatives to reduce, reuse and recycle (the "3 Rs") will help achieve this target. The 3 Rs will also save on energy used to manufacture products, such as paper products and aluminum cans, which will tend to further reduce GHG emissions.

**38. Enforce the province's Landfill Criteria to control the escape of methane and other gases from landfills.**

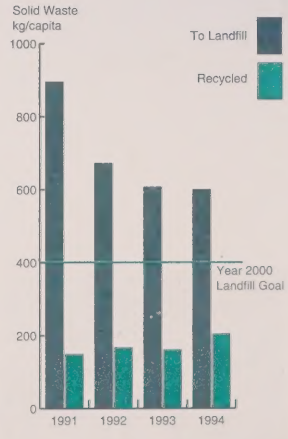
Landfill criteria for municipal solid waste were introduced in June 1993. These criteria are required as part of the municipalities' Solid Waste Management Plans to be prepared by the end of 1995. Currently, all landfills greater than 100 000 tonnes total waste capacity must carry out an assessment to determine the need for gas management. Where a system is installed, it is preferred that the gases be recovered for energy, or otherwise incinerated or flared, rather than being directly vented to the air. Incineration and flaring convert methane to $CO_2$, which is about 25 times less damaging as a greenhouse gas.

## Cross-Sectoral Actions

A number of actions cut across the major sectors emitting greenhouse gases, and are largely regulatory in nature. B.C. needs an efficient, fair system of environmental regulations that allocates responsibility for GHG management to all sectors involved. The province will work towards a market-based approach that encourages emitters to cooperate and find cost-effective solutions to the greenhouse gas problem.

**39. By early 1996, issue formal social costing guidelines to incorporate the impacts of GHG emissions and their management into regulatory decisions about new projects or resources.**

During the public consultation process, representatives from utilities and pipeline companies asked for government guidance on how to account for GHG emissions in their everyday business and planning




*By the end of 1994, B.C. had achieved a 25% reduction in municipal solid waste sent to landfill.*

### What Government is Doing

Major legislative and policy efforts by the Ministry of Forests—e.g. the Forest Renewal Plan and Forest Practices Code—are ensuring more sustainable management of B.C. forests.

The Canadian Forestry Service's Pacific Region has jointly sponsored research on improving energy efficiency in forest management and wood products manufacturing, and techniques to compare the life-cycle $CO_2$ impacts of different building materials.

At the Pacific Agriculture Research Centre, Agriculture and Agri-Food Canada has identified sources and sinks for $CO_2$, methane and nitrous oxide related to B.C. agricultural operations. It is also conducting a research program with Environment Canada to reduce GHG emissions through better manure management practices.

decisions. In particular, industry wanted direction on evaluating the social costs of their emissions. Coincidentally, in the Electricity Market Review, the B.C. Utilities Commission recommended that consistent social costing principles be developed for regulated utilities.

B.C.'s electric and gas utilities have applied social costing principles in preparing their integrated resource plans. However, there is considerable variation in the methodologies and dollar cost values (implicit or explicit) used to assess GHG impacts for resource planning purposes. A consistent social costing framework is needed for consideration of greenhouse gases in public sector programs, policies and project evaluations. This framework will be applied until broader, market-based approaches to determining environmental costs are available (see Actions 40 and 44). Several government ministries, along with the Utilities Commission, will prepare draft social costing guidelines for public review at a workshop in early 1996. Formal guidelines will be issued shortly after.

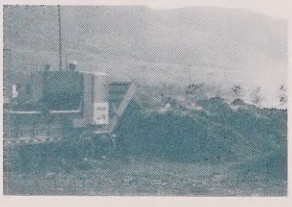
**40. Work with industry on a voluntary pilot program to test GHG offset projects in B.C.**

One of the tools for GHG management mentioned at the industry focus group meetings was coordination among sectors to identify and act on specific mitigation opportunities. Participants suggested that all sectors could come together in some kind of forum to "broker" $CO_2$ offset projects. The goal would be to better identify the costs of mitigation and target the most cost-effective emission reduction measures. A voluntary pilot offset and brokering program for industry could provide the transition to a more comprehensive system of tradeable permits for mobile and stationary emission sources (Action 44).

Ideas for offset projects are already emerging. There are many issues to be resolved including: how offsets would be defined and measured; who would be responsible for evaluating their acceptability; how performance would be assessed; and who would receive credit for the offsets, to avoid double counting. The province will

### The Damage Costs of GHGs

*Policy action requires some assurance that the benefits of reducing greenhouse gases—namely, the avoided damages from climate change—exceed the costs of mitigation. Estimates of damage costs are highly controversial, due to uncertainty about the impacts of a doubling of $CO_2$ concentrations and the inherent difficulty of assigning dollar values to environmental damages, such as loss of human life, especially across countries and generations. The IPCC's Working Group III reports published damage cost estimates of between $5 and $125 (1990 U.S.) per tonne of $CO_2$, but cautions that this does not reflect the full range of uncertainty (IPCC 1995b). For developed countries, the costs equate to 1.0% to 1.5% of GDP, while for developing countries they are estimated at 2% to 9% of GDP.*



*The City of Kamloops reduced landfill waste by 40%, mainly through composting.*

Success Stories

### What Industry is Doing

MacMillan Bloedel has switched from heavy fuel oil to natural gas at its Port Alberni mill, and increased hog fuel combustion. A fluidized bed boiler is being evaluated for Powell River, which would further increase hog fuel use and decrease fuel oil consumption.

At its Howe Sound pulp mill, Canadian Forest Products (Canfor) reduced $CO_2$ emissions by a measured 74 kilotonnes (40%) between 1990 and 1994, through the installation of a hog fuel boiler.

In the past three years, Weyerhauser Canada has shut down three beehive burners, with wood residue either going into product or being burned in hog fuel boilers at its Kamloops operations.

work with industry to create a process for piloting offset projects in B.C.

**41. Support pollution prevention planning in the public and private sectors.**

The Ministry of Environment, Lands and Parks has been placing more emphasis on preventing pollution, to balance a traditional focus on controlling and monitoring waste discharges. Pollution prevention is an approach to environmental management that avoids, eliminates and reduces pollution at the source, rather than treating or containing it once it exists. The goals are to ensure more complete product stewardship, reduce the use of energy and other resources, and lower emissions.

The province is developing procedures to help major industrial operations prepare pollution prevention plans. Typically, these plans involve examining the company's entire industrial process to eliminate the use of hazardous raw materials, introduce clean process technologies, and reuse and recycle byproducts. The Canadian Environmental Technology Advancement Corporation (CETAC) provides a new tool to help bring pollution prevention and control technologies to market. CETAC's target market includes technologies designed to mitigate the greenhouse gas problem.

**42. Amend other provincial policies and processes to explicitly consider greenhouse gases in public and private decision-making.**

So far, GHG impacts have been addressed on a fairly ad hoc basis in the province's regulatory and policy-making processes. In 1993, greenhouse gas management plans were requested for several energy project proposals, including Westcoast Energy's development of natural gas facilities and B.C. Hydro's expansion of the Burrard Thermal Generating Plant. The province will formalize the treatment of greenhouse gases by:

- developing project review requirements for GHGs for the Ministry of Environment, Lands and Parks' evaluation of projects as input into the Environmental Assessment Process;

- requiring provincial Crown corporations to incorporate GHG objectives into strategic and business plans, include emission impacts in their Multiple Accounts Framework, and to report GHG emissions on an annual basis; and

- altering the cabinet submission format to distinguish greenhouse gases within the broader "Environmental Implications" category used to evaluate policy options.

**43. Evaluate options for regulating greenhouse gas emissions.**

Regulating GHG emissions would provide emitters with the economic incentive to reduce their emissions, through some combination of energy efficiency, fuel switching and process changes. Furthermore, emission permits are a prerequisite to the use of economic instruments for environmental management, such as offsets or tradeable permit programs that may evolve in the future for greenhouse gases. B.C. will

### What Industry and Governments are Doing

Under Tree Plan Canada's Regional Partners Program, the Canadian Forestry Service and the National Community Tree Foundation have planted 1.3 million trees in B.C. since 1992.

Lafarge Canada Inc. uses biogas (recovered from a nearby landfill) and tire-derived fuel at its cement plant in Richmond.

Over the next three years, the Capital Regional District will be reducing landfill gas emissions by upgrading the Hartland Landfill gas collection system and installing an aerobic vegetable-waste composting operation.

investigate the implications of different options for regulating GHG emissions.

One option would be to include GHGs in the *Waste Management Act* and associated *Waste Management Permit Fees Regulation*, which currently require permits for discharges to the environment and include provisions for fees for "other airborne discharges." However, the regulation would require an amendment to incorporate GHGs as a separate category of discharges, in order to ensure a practical fee structure. A fee structure would be developed specifically for these gases, with fees charged either on the emissions of each gas or on its $CO_2$-equivalence. Should such an amendment be pursued, further input from stakeholders would be sought.

**44. Evaluate options for developing a system of tradeable emission permits for greenhouse gases and other major air pollutants in B.C.**

### Tradeable Emission Permits

*Emission trading programs set a total limit on emissions in an airshed, and then allocate the limit across emission sources. Emitters receive credits for reducing their emissions below allowed levels. These credits can then be bought and sold. The U.S. Environmental Protection Agency has had a sulphur dioxide trading system in place since the 1970s. While they can be administratively complex, tradeable emission permits encourage the pursuit of least-cost mitigation measures.*

Since 1992, several studies have considered a system of tradeable emission permits to control air quality problems in the Lower Fraser Valley. Most recently, a report commissioned by Environment Canada, the Greater Vancouver Regional District, and the Ministry of Environment, Lands and Parks outlined the benefits of airshed emission limits and transferable permits (ARA 1995). The Lower Mainland offers some unique institutional features—a central registry of all vehicles (ICBC), a vehicle emissions testing program (AirCare) and the regional administration of point-source permits—that could be used to administer such a system.

An intergovernmental committee is continuing research on the feasibility of emission limits for $CO_2$, nitrogen oxides, volatile organic compounds and inhalable particulates. The Air Quality Cost Benefit/Economic Instruments Committee will be used to further investigate the mechanics, and administrative and regulatory hurdles, of a tradeable permit scheme. B.C.'s draft *Environmental Protection Act* would allow for permit trading through the introduction of a regulation. At present, trading can take place between permit holders under the jurisdiction of the *Waste Management Act*.

## Science, Education and Awareness

The complexities of greenhouse gases and climate change, and their impacts and mitigation can be overwhelming, even for those who have some familiarity with them. There is a clear need for more public education and information sharing on how to address the GHG problem, particularly

Success Stories

### What Industry is Doing

A group of western energy companies have formed GEMCo., the Greenhouse Gas Emissions Management Consortium, to look for and develop emission offset opportunities. Westcoast Energy chairs GEMCo., whose 12 other members include BC Gas and B.C. Hydro.

B.C. Hydro's recent call for 300 MW of privately generated power inspired project proponents to come forward with innovative offset ideas. The utility has indicated that it will consider these offsets when ranking shortlisted proposals.

B.C. pulp and paper mills have undertaken massive fuel switching from fossil to biomass fuels over the past 15 years. Many companies have committed to the CIPEC target to reduce fossil fuel use by 1% annually during the next five years.

in the context of other environmental issues facing the province.

**45. Expand the Ministry of Environment, Lands and Parks' Environmental Award Program to include GHG emission reduction.**

The public consultation process revealed a substantial number of actions in which private companies and communities are involved that carry emission reduction benefits. GHG reductions resulting from these voluntary actions must be quantified and acknowledged, to reward the participants and demonstrate leadership to other members of their sectors. As the action plan is implemented, industry and local government will be asked to submit success stories describing their management measures and quantifying the magnitude of greenhouse gas impacts.

**46. In partnership with the federal government, sponsor research on the impacts of global climate change and its mitigation on: (1) B.C.'s weather patterns, coastline and natural resources; and (2) the provincial economy.**

Research is underway at the provincial and national levels, to assess the impacts of climate change and GHG mitigation. In September 1990, the University of British Columbia held a Global Environmental Change Conference, which examined the possible impacts of climate change on biological systems, social systems and resource planning. The Ministry of Forests co-sponsored a Symposium on the Implications of Climate Change for Pacific Northwest Forest Management in October 1991. The School of Resource and Environmental Management at Simon

### Public Action Tip Five
### At the Store

How you shop can have a significant effect on energy use and GHG emissions:

- *Planning to replace your vehicle? Go for a smaller, fuel-efficient model with lower emissions and better gas economy. Buy for your everyday use, rather than getting a larger vehicle that you rarely need, and which you can borrow or rent. Choose options that tend to lower fuel consumption (e.g. radial tires and cruise control) over ones that increase it (e.g. air conditioning).*
- *When shopping for refrigerators, stoves and other appliances, buy Power Smart and use the EnerGuide label to compare models.*
- *Shop locally, whenever possible, and look for environmentally friendly products that are manufactured in less energy-intensive and less GHG-intensive ways—for example, using recycled paper or plastic.*
- *Follow the 3 Rs—reduce, reuse and recycle—before you make a new purchase.*
- *Buy a live Christmas tree and plant it in your yard afterwards.*

*The Go Green public awareness program promotes alternatives to the single occupant vehicle*

### What Government and Industry are Doing

There are six ongoing pilots to showcase pollution prevention planning in B.C. industry, with Riverside Forest Products, Fletcher Challenge, Cominco Metals, FMC Chemicals, Tilbury Cement and Westcoast Energy.

CETAC-WEST is a new private sector service company seed-funded by government to help small and medium-sized enterprises commercialize environmental technologies. Among its services CETAC provides expertise to assess technology companies, develop a commercialization strategy and identify demonstration opportunitires. It is not a funding agency, but does assist companies in accessing financing.

Alcan Smelters and Chemicals plans to install point break feeders at its Kitimat aluminum smelting operations, to reduce polyfluorocarbons and improve electrical efficiency. On a national level, Alcan has committed to a 50% reduction in PFCs.

Fraser University has been analyzing measures to achieve the provincial stabilization goal and the potential impacts of this mitigation on the B.C. economy.

British Columbians need to know more about the potential effects of climate change on the sea level along our coasts, patterns of precipitation and drought, and provincial forestry, fisheries and agricultural resources. The province will cooperate with universities, research organizations, Environment Canada and others in researching both adaptation and mitigation for greenhouse gases and climate change.

**47. Institute a public education program to inform B.C. citizens about climate change, GHG emissions and their management.**

From the public consultations, it became apparent that stakeholder groups and British Columbians as a whole want more information on the science of greenhouse gases and climate change, and the implications for their lives and activities. In some cases, stakeholders had initiated management measures, such as energy efficiency improvements and the use of alternative fuels, but did not make the connection to reducing GHG emissions. In other cases, members of industry and the public shared innovative ideas and solutions for GHG management. Generally, there was confusion as to how greenhouse gases fit with B.C.'s other major air quality issues such as ground-level ozone, fine particulates and stratospheric ozone depletion.

The province will work with industry and other levels of government to develop a public education program on greenhouse gases and climate change, in the larger context of atmospheric emissions. This program will provide a forum for exchanging information on the current science, measures to reduce GHG emissions, policy options and success stories. It will use a variety of media, including brochures, newsletters, videos, educational kits, seminars and electronic access to information.

## Local Government

A number of B.C. municipalities and regional districts—such as the GVRD, Capital Regional District, and the cities of Vancouver, Victoria and Kamloops—have been planning and carrying out measures to reduce greenhouse gas emissions. These efforts have shown leadership and a genuine concern over global climate change. However, at the local level, politicians and citizens alike often do not realize that greenhouse gases are an environmental priority comparable to, and linked with, local air pollution.

**48. Support local actions to achieve GHG reduction targets, through air quality management plans and joint provincial/municipal initiatives.**

The GVRD is moving to implement its 1994 Air Quality Management Plan to cut local air pollution by 50% and reduce greenhouse gases as a secondary objective. The province encourages the development and implementation of air quality management plans, including goals and measures

Success Stories

### What Communities and Others are Doing

GO GREEN, a community-based program promoting transportation alternatives, has achieved more than 70% public awareness in the space of five years. Its annual Air Quality Awards recognize achievements in vehicle trip reduction.

B.C. environmental groups have been addressing climate change for a decade now, and have made it an issue when debating land use planning, forestry, energy, tourism, waste management and sustainable development.

VanCity Credit Union rewards employees who use alternative transportation with "Greenbucks," which they can use to purchase products of their choice.

for GHG emission reduction, by B.C.'s major municipalities and regional districts. Therefore, it will work with local governments to impress upon their representatives the seriousness of B.C.'s GHG commitment and the need for local action in conjunction with other pressing air quality issues.

During the public consultations, local governments indicated a willingness to expand the use of renewable and alternative fuels in their vehicle fleets. However, individual municipalities and regional districts generally do not have enough purchasing power to obtain these vehicles in quantity. The province will evaluate a program to enable joint purchases of alternative fuel vehicles in conjunction with the provincial fleet purchase policy (Action 5). Other joint purchasing efforts, such as for energy efficient office equipment, will be reviewed and developed with local agencies.

**49. Assist in the development of regional growth strategies for B.C.'s fastest growing communities.**

In May 1995, B.C. passed the *Growth Strategies Statutes Amendment Act*, enabling municipalities and regional districts to develop and implement strategies that manage growth. The act identifies a number of goals to guide regional growth strategies and official community plans, including "planning for energy supply and promoting efficient use, conservation and alternative forms of energy." This legislative framework encourages the kind of integrated land use and transportation planning that can substantially improve energy efficiency. It will allow the provincial and local governments to form partnerships for the development of innovative solutions to urban sprawl, air pollution and other problems faced by our rapidly growing

### Public Action Tip Six
### In Your Community

You can have an impact on greenhouse gas emissions in your neighbourhood:

- *Arrange carpools for your children's team events, your fitness classes, community meetings and other group activities.*
- *Work with your child's school to make it more energy efficient and environmentally friendly.*
- *Support local planning that encourages higher density redevelopment, as opposed to more urban sprawl and shopping centres geared toward the automobile user.*
- *Get involved in developing a community energy plan that considers how to best meet local energy needs along with housing, transportation and other services.*
- *Encourage your local government to construct bicycle lanes and bike parking facilities, and to make urban centres safer for walking.*

### What Universities are Doing

The Canadian Institute of Climate Studies, based at the University of Victoria, manages a climate research network. Research is focusing on the processes that control climate systems and new climate modelling techniques, to improve our ability to predict and adapt to climate change.

UBC's Sustainable Development Research Institute (SDRI) has had a lead role in the IPCC's Working Group III on socio-economic issues. SDRI has two other research programs underway on environmental adaptation and an evaluation of the potential for large-scale GHG reduction.

The School of Resource and Environmental Management at Simon Fraser University is working with CIPEC to produce credible industry energy statistics and forecasts using its Canadian Industry Energy End-Use Database.

communities. The act also empowers the province to give direction on restricting urban sprawl.

## National Actions

Canada's National Action Program on Climate Change consists of a series of strategies to mitigate GHG emissions, improve scientific knowledge about climate change, adapt to the impacts of that change, and review progress towards achieving the national emissions stabilization goal. Mitigation strategies include actions by the federal government itself, partnership measures with industry and other countries, and targeted sectoral actions. A major national effort is the Voluntary Challenge and Registry Program, which seeks voluntary action by industry associations, individual companies and major municipalities.

**50. Actively encourage B.C. industries and local governments to participate in the national Voluntary Challenge and Registry Program.**

Of the roughly 1 600 individual companies that have been contacted across Canada, just over 120 B.C. firms have been asked to sign onto the program and submit action plans. A number of those contacted have already made commitments and sent in their plans. Those received by the end of September 1995 were reported on at the November meeting of Canada's environment and energy ministers.

So far, at the national level, various companies and industry associations have committed to the Voluntary Challenge. B.C. participation in the program is critical to meeting both the federal and provincial stabilization goals. The B.C. government will encourage companies, as well as major municipalities, to commit to significant GHG reduction measures within the province, and will track their progress through the national program.

**51. Work with the federal government and industry to ensure that voluntary actions are separated out at the provincial level.**

Industry actions under the Voluntary Challenge and Registry Program are being aggregated into national totals for the participants. B.C. needs provincial detail, in order to track progress towards our year 2000 and long-term emission reduction goals. The province will work with NRCan and industry associations to see that the registry identifies GHG measures and estimated reductions specific to B.C.

**52. Encourage the Canadian Government to make all Crown corporations and federally regulated agencies part of the GHG reduction effort.**

The Canadian government must ensure that actions taken to reduce GHG emissions within government are applied equally to all federal Crown corporations and federally regulated agencies. In the interests of providing leadership and maximizing the emissions reduction, the federal government should extend the coverage of its programs.

*Municipal bike paths provide safe passage for cyclists and help support alternative modes.*

Success Stories

### What Government is Doing

The Canadian Government recently passed legislation to run half the federal vehicle fleet on alternative fuels by 1997, and 75% by 2004. Industry has pledged up to $50 million in infrastructure investment for new natural gas vehicles.

The Federal Buildings Program has reduced energy use in government offices by 15-20% or more. Similar programs are now being developed or implemented in New Brunswick, Nova Scotia, Ontario, Saskatchewan and the Yukon.

Canada's first joint implementation pilots are expected to be registered in 1996. Guidelines are being drafted to help proponents develop project proposals.

The National Biomass Ethanol Program provides support to encourage firms to invest in the Canadian ethanol industry.

**53. Strongly urge the implementation of an aggressive package of GHG management actions at the federal level.**

The Canadian government has promised actions beyond its voluntary challenge to industry and municipalities. These actions include federal leadership initatives in buildings and vehicles, a shift in energy research and development to energy efficiency and renewables, and more carbon sink research.

The province urges the federal government to implement a more aggressive package of federal actions. This package could be drawn from the findings of the 1994 Climate Change Task Group, which identified more than 80 possible measures for tackling climate change. Stronger national actions could encompass:

- introduction of improved fuel consumption standards for new vehicles;
- redirection of subsidies away from fossil fuels;
- tax incentives or rebates for energy efficient buildings and equipment;
- joint implementation programs with other countries; and
- a modal shift to more efficient forms of inter city transportation, such as rail.

Actions such as these may well be needed if Canada and B.C. are to meet their emissions stabilization goal for the year 2000.

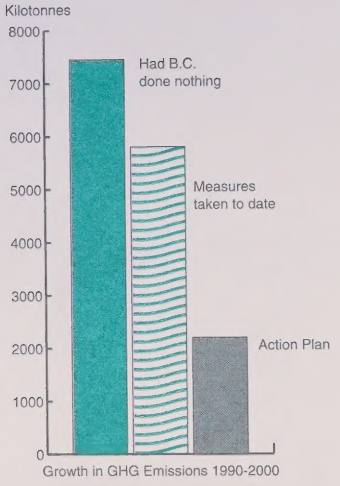
# Conclusions & Next Steps

This action plan has described the significant actions being taken by governments, industry and the public towards B.C.'s goal to stabilize greenhouse gas emissions at 1990 levels by the year 2000. The plan itself consists of 46 committed provincial actions, as well as seven options for further study, development and consultation. The next steps will be to measure progress towards the stabilization target, determine where additional action is needed, and further develop the plan through ongoing public consultation.

## Progress To Stabilization

The chart to the side shows the progress made towards reducing the growth in B.C.'s GHG emissions under three different scenarios: (1) if we had done nothing since 1990 to manage these emissions; (2) if we do no more than the actions taken to date; and (3) if we do the provincial actions and options in this plan. Since a number of the planned actions and all of the options are still developmental, the magnitude of their emission impacts are currently not well known. Moreover, the action plan does not include emission reductions from:

- voluntary action by B.C. industry and municipalities under the national Voluntary Challenge and Registry Program, whose impacts have yet to be estimated;
- federal actions affecting B.C. under the National Action Program, also of uncertain impact at this time;
- sustainable forestry and agricultural practices which, according to our prevailing knowledge, are unlikely to provide a significant long-term offset for fossil fuel emissions; and
- fiscal measures, such as taxes, in light of the province's freeze on new taxes and tax increases.




*Provincial actions make considerable progress, but will not eliminate the expected growth in emissions between 1990 and 2000.*

With these caveats, B.C.'s Action Plan is expected to slow the growth in GHG emissions to about 2.3 megatonnes by the year 2000, 4% higher than 1990 levels. While the provincial actions in this plan make considerable progress, they will not achieve stabilization. Cutting the growth in emissions to zero will require strong and demonstrable action from federal and local governments and industry, through the Voluntary Challenge and other efforts. If this action does not move us substantially closer to stabilization, the B.C. government may have to take stronger provincial measures.

## Measuring Progress

Progress towards meeting Canada's and B.C.'s GHG reduction goal will be monitored on an ongoing basis, to assess whether additional action is required and, if so, in what sectors. B.C. will work with the federal and other provincial governments, municipalities and regional districts, and industry to:

- Monitor greenhouse gas emissions, including regular updates to the provincial emissions inventory starting in 1996.
- Develop a common framework of monitoring procedures and standardized indicators, for measuring progress in emission reduction. The framework will be prepared with Natural Resources Canada, as part of the national Voluntary Challenge and Registry Program. Indicators, such as energy efficiency and fuel use trends, will be developed jointly with industry associations and individual companies. The information will be used to update provincial forecasts of GHG emissions.
- Track the important contribution of voluntary action through the Voluntary Challenge and Registry. B.C. does not intend to establish its own registry of voluntary commitments and actions; however, because of the commitment to stabilize provincial emissions, it is essential that the national registry report provincial-level

## More Ideas for Action

*B.C.'s GHG Action Plan consultation process attracted valuable input from non-government organizations, as well as individual British Columbians. Here are some of their suggested actions, which may be considered for future implementation in B.C.:*

***Increase the use of solar energy for heating by:***

- *substituting solar technology for electric and gas-fired domestic water heaters, swimming pool heaters and some commercial water heating;*
- *orienting new homes and buildings and placing windows to maximize the capture of solar energy; and*
- *guaranteeing solar access through bylaws to prevent new buildings from shading adjacent properties that use solar energy.*

***Use economic instruments to reduce greenhouse gases by:***

- *removing subsidies for fossil fuel exploration and production infrastructure;*
- *introducing a national carbon tax; and*
- *adopting a GHG feebate system which would tax emissions above a set level and provide rebates or incentives for emissions below that level.*

***Increase the use of renewable energy power generation by:***

- *introducing voluntary green pricing for renewables, which would allow consumers the option of paying a premium for power from renewable sources; and*
- *allowing small power producers, such as solar, wind and micro-hydro systems, to connect to the main electrical grid and sell surplus power to the utility.*

***Encourage increased energy efficiency by:***

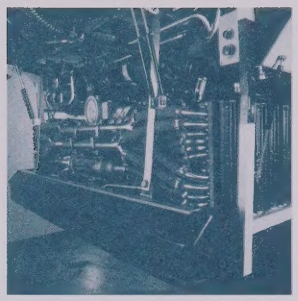
- *providing loans for energy retrofits, to be paid back from energy bill savings;*
- *introducing energy retrofit standards that would require homes and buildings to have energy upgrades to a set efficiency level before they can be sold; and*
- *expanding Power Smart and other utility demand-side management programs; and*
- *promoting ground source heat pump technology.*

***Reduce transportation GHG emissions by:***

- *supporting alternative transportation fuels that produce fewer GHGs;*
- *introducing zero emission vehicles;*
- *promoting telecommuting; and*
- *removing subsidies for parking.*

***Enhance carbon sinks by:***

- *introducing offsets for all new GHG emitting projects;*
- *removing subsidies on marginal agricultural land; and*
- *funding tree planting programs.*



*Ballard Power Systems' hydrogen fuel cell technology is being demonstrated in transit buses, and could be adopted to automobiles early in the next century.*

data. In 1996, B.C. will participate in a national evaluation of the Voluntary Challenge and Registry. This review will indicate whether voluntary actions by the public and private sectors are actually reducing GHG emissions. The impact of voluntary efforts in B.C. will also be evaluated on an ongoing basis.

- Review, on a yearly basis, the actions in the B.C. Greenhouse Gas Action Plan, beginning in the fall of 1996. This review will be coordinated with the first report on achievements under the Voluntary Challenge.

## Further Consultations

The province will continue to consult with the public, industry and other stakeholders in the development of measures and policy instruments to reduce greenhouse gas emissions. For example, extensive consultations have already taken place on the B.C. Energy Council's provincial Energy Strategy, emissions and fuel standards under the Clean Vehicles and Fuels Program, and energy codes for houses and buildings. Stakeholders will also be consulted on the new initiatives and options presented in this action plan.

## A Last Word from a Concerned Citizen

Here are some excerpts from a letter written by a Vancouver resident and submitted as part of the B.C. Greenhouse Gas Action Plan consultation process:

*...I am the head of a Canadian household, millions of which are responsible for the largest part of emissions of greenhouse gases directly through combustion of fuels for heat and transportation, and indirectly through consumption of energy and energy-intensive products and services.*

*...Since November 1994, we have transferred all everyday car travel demand of the family onto the 'greener' transportation modes of urban transit, bicycling and walking. Only those trips that are not possible with alternative modes (haulage of large and heavy items, motoring vacations, urgent trips, reaching destinations where urban transit is impractical) are being made using taxis, rented vehicles and the courtesy of friends with vehicles. In addition, I have negotiated with my employer a telecommuting status from mid-November 1994 until the end of September 1995 for two days per week. I supported the status with personally owned microcomputer and fax machine.*

*Our annual distance travelled used to be about 12 500 km. At an average fuel consumption of 12 litres of gasoline per 100 km (combined city and highway), we used to consume about 1 500 litres of gas fuel per year. Including methane and nitrous oxide emitted from combustion of the gasoline, we used to generate the following quantities of greenhouse gases (in $CO_2$-equivalent units):*

1 500 l x 2.36 kg $CO_2$/l= 3 540 kg $CO_2$-equivalent
1 500 l x 1.5 kg $CH_4$/1 000 l x 24.5 kg $CO_2$/kg $CH_4$ = 55 kg $CO_2$-equivalent
1 500 l x 1.0 kg $N_2O$/1 000 l x 320 kg $CO_2$/kg $N_2O$ = 480 kg $CO_2$-equivalent

Total Direct GHG emissions = 4 080 kg $CO_2$-equivalent

*...In addition to the directly emitted GHGs, our car embodied 0.44 extra units of energy for every unit of energy consumed directly in fuel consumption. This indirect energy was embedded into the vehicle during its production, delivery and maintenance. Indirect energy was also embedded in the production and supply of the gasoline fuel consumed by our car. Assuming that GHGs are proportional to energy used, the total GHG emissions from our car (direct and indirect) reached almost 6 tonnes of $CO_2$ equivalent per year.*

*We estimate that about 80 percent of our demand for car trips has been eliminated or switched to the more energy-efficient urban transit. We have thus eliminated between 4 and 5 tonnes of GHG emissions annually, including direct and indirect emissions. By freeing the road space previously occupied by our car, we have reduced the need for road and parking infrastructure, which reduces the GHG emissions directly by reducing congestion, and indirectly by*

*saving the energy needed to build and maintain the infrastructure. We are also helping to reduce air pollution in the airshed in which Greater Vancouver is located, attenuate traffic noise, reduce soil contamination at gas stations, and lessen water pollution from paved areas.*

*For every one million Canadian households following suit, the country could save some 5 Mt of $CO_2$ equivalent annually, i.e. about one percent of the 1990 national emission level.*

*We are members of the most important target group regarding GHG emission reductions: the consumers. It is millions of everyday actions and decisions by this group which will determine the success or failure of the stabilization target. We are determined to continue our action and to provide an example to other Canadians...*

The writer goes on to state that the family can only maintain its leadership role with the support of government action—for example, more and better mass transit, construction of bicycle lanes, financial disincentives to automobile use (gasoline taxes and tolls), tax breaks and subsidies for cyclists and transit users, and support for telecommuting. These kinds of initiatives are mentioned throughout the action plan above.

## Your Comments are Invited

Send your comments on B.C.'s Greenhouse Gas Action Plan to:

B.C. Ministry of Environment,
Lands and Parks
Air Resources Branch
2nd floor, 777 Broughton Street
Victoria, B.C. V8V 1X4
Tel: (604) 387-9933
Fax: (604) 356-7197
E-mail: ghg@epdiv1.env.gov.bc.ca

B.C. Ministry of Energy, Mines and
Petroleum Resources
Energy Management Branch
7th floor, 1810 Blanshard Street
Victoria, B.C. V8V 1X4
Tel: (604) 952-0242
Fax: (604) 952-0241
E-mail: empmail@galaxy.gov.bc.ca

# For More Information

You can learn more about greenhouse gases and climate change, management measures and the provincial policies described in this report from several appendices to the action plan, and a number of other publications and contacts.

## Action Plan Appendices

The following are available separately on request from the relevant ministries:

B.C. Ministry of Environment, Lands and Parks, 1995. *B.C. Greenhouse Gas Action Plan Consultation Process.*

B.C. Ministry of Environment, Lands and Parks, 1995. *Update on Climate Change Science.*

B.C. Ministry of Forests, 1995. *Primer on Forests and $CO_2$.*

## Other Selected Publications

**Available from:**
B.C. Ministry of Energy, Mines and Petroleum Resources
Communications and Public Affairs Branch
8th floor, 1810 Blanshard Street
Victoria, B.C. V8V 1X4
Tel: (604) 952-0152
Fax: (604) 952-0151
E-mail: empmail@galaxy.gov.bc.ca

*Towards Energy Sustainability: Implementing the B.C. Energy Council's Energy Strategy for B.C.,* 1995.

*Cleaner Fuels for Cleaner Air: The Role of Alternative Transportation Fuels in B.C.,* 1994.

**Available from:**
B.C. Ministry of Environment, Lands and Parks
Air Resources Branch
2nd floor, 777 Broughton Street
Victoria, B.C. V8V 1X4
Tel: (604) 387-9933
Fax: (604) 356-7197

*Clean Vehicles and Fuels for British Columbia: A Policy Paper,* 1995.

*The Enhanced Greenhouse Effect and Global Climate Change.*

*Greenhouse Gas Inventory and Management Options: A Summary Report for British Columbia, 1992.*

**Available from:**
B.C. Crown Publications
521 Fort Street
Victoria, B.C,
Tel: (604) 386-4636
Fax: (604) 386-0221

*Energy Supply and Requirements Forecast 1993-2015* (Ministry of Energy, Mines and Petroleum Resources), 1993.

*Evaluation of $CO_2$ Management Measures* (Ministry of Environment, Lands and Parks), 1992.

*An Inventory and Analysis of Control Measures for Methane for British Columbia* (Ministry of Environment, Lands and Parks), 1992.

*British Columbia Emission Inventory of Nitrogen Oxides, Volatile Organic Compounds and Ozone ($NO_x$/VOC/$O_3$) as Greenhouse Gases* (Ministry of Environment, Lands and Parks), 1992.

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Greater Vancouver Regional District, 1994. *Livable Region Strategic Plan.*

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IPCC Working Group III, 1995b. *Second Assessment Report: Draft Summary for Policymakers.*

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Oregon Department of Energy, 1995. *Report on Reducing Oregon's Greenhouse Gas Emissions.*

The ARA Consortium and Schotz & Associates, 1995. *Potential Economic Instrument Approaches to Air Quality Management in the GVRD.*

United Nations, 1992. *United Nations Framework Convention on Climate Change.*

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